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Performance of Prefabricated Geocomposite Subdrainage System in an Airport Runway

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Final Report

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16. Abstract

A Prefabricated Geocomposite Subdrainage (PGS) system installed in Runway 09-27 at Kewanee Municipal Airport in 1985 was evaluated. The study demonstrated that a PGS system could be installed within the active runway area at a distance of 12.5 ft on either side of the centerline. There were no problems with settlement or distresses along the installation location.

Subdrainage outflow measurements indicated that 25% to 45% of the rainfall water infiltrated the pavement and passed through the PGS system. Subdrainage outflows varied but a maximum outflow of over 1700 gal/hr was measured during the study. It was observed that water flow from the pavement joints and cracks ceased once the PGS system was installed.

The FWD data indicated that the subgrade soil beneath Runway 09-27 ranged from less than 1 ksi to generally 3 ksi. Although there was some improvement in subgrade strength during the study period it was not possible to conclude that subdrainage was totally responsible for this improvement. There was an indication from the data analysis that there could be some raveling in the lower half of the full-depth asphalt concrete layer.

The PCI study conducted on Runway 09-27 provided results from 1981 to 1990. The PCI ratings obtained after installation of the PGS system in 1985 indicated the possibility of some overall improvement in pavement performance. Visual observations indicated that surface seepage of water and frost heave problems did not occur again after installation of subdrainage. Visual inspection in January 1993 indicated there was no evidence of longitudinal reflective cracking in the 3 in. asphalt concrete overlay, that was placed during the summer 1990, in the area above the PCS system.

It would appear that the PGS system is continuing to function properly and that Runway 09-27 at Kewanee Municipal Airport is performing very well.

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METRIC CONVERSION FACTORS

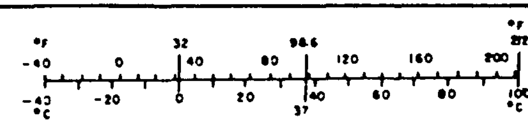
Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

* 1 in. = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10 286.

Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



PREFACE

This Final Report on "Performance of Prefabricated Geocomposite Subdrainage System in an Airport Runway" was prepared for the U.S. Department of Transportation, Federal Aviation Administration with the direct supervision of the U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi under Contract Number DACA 39-878-K-0061. Dr. Walter R. Barker was the project monitor for the U.S. Army Engineer Waterways Experiment Station.

The contributions of University of Illinois research assistants John P. Donahue and Gregg E. Larson for the collection and processing of field data from Kewanee Municipal Airport are acknowledged.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

FIGURE PAGE

LIST OF FIGURES CONTINUED

INTRODUCTION

Study Location

In the Fall of 1985 a prefabricated geocomposite subdrainage (PGS) system was installed in Runway 09-27 at Kewanee Municipal Airport for the purpose of reducing the influence of differential frost heave and other water related distresses. Kewanee Municipal Airport is located 3 miles southwest of Kewanee, Illinois at latitude 41°12'20" and longitude 89°57'45" with an average elevation of 856.0 MSL. The airport was constructed in 1975. Runway 09-27 is the primary runway and it is presently 4500 ft long by 75 ft wide. A secondary cross-wind runway designated 01-19 is located near the east end of Runway 09-27. Runway 01-19 is 3200 ft long and 60 ft wide. Both Runway 09-27 and Runway 01-19 have asphalt concrete surfaces.

A unique feature of the subdrainage installation on Runway 09-27 was the fact that a PGS material was used and it was installed in 4-in wide slots at a distance of 12.5 ft on either side of the runway centerline. Conventional 6 in. diameter corrugated perforated polyethylene tubing was placed at the outside edges of Runway 09-27. Because of the newness of the materials used and the installation locations, a follow-up study was initiated to evaluate the performance of the unique PGS system and its effect on the performance of the runway.

Study Objectives

The main objective of this project was to evaluate the drainage performance of a PGS system installed in Runway 09-27 at Kewanee Municipal Airport and to determine if pavement performance was improved. The specific study objectives are as follows:

1. Install outflow meters on the PGS system and relate the flow volume to precipitation events.
2. Conduct periodic falling weight deflectometer (FWD) tests on Runway 09-27 to determine if subdrainage installation improved deflection properties.
3. Monitor changes in pavement condition that have occurred since subdrainage installation by using ASTM D5340-93, Standard Test Method for Airport Pavement Condition Index Surveys.
4. Evaluate the subgrade and pavement properties necessary for conducting subdrainage analysis on Runway 09-27.

ORIGINAL PAVEMENT AND SUBGRADE CONDITIONS

Runway 09-27 was constructed in conjunction with the rest of the airport facilities in 1975. The runway was constructed as an 8 in. full-depth asphalt concrete pavement which was placed directly on the compacted subgrade. The full-depth pavement section consisted of 6 in. of Illinois Department of Aeronautics (IDOA) P201 asphalt concrete subbase and 2 in. of IDOA P401 asphalt concrete surface. The runway was originally 3900 ft long by 75 ft wide. It was extended to 4500 ft in the Summer of 1990 when the entire runway was overlaid with an average of 3 in. of asphalt concrete which included an IDOA PV02 friction course.

The longitudinal gradient for the centerline of Runway 09-27 is shown in Figure 1. Figure 1 shows both the original grade line and the finished grade line after the asphalt concrete overlay was placed in 1990. The original pavement had a cross-slope from the centerline to the edge of about 1.5%. This slope was increased to a range of 1.5% to 2.0% when the asphalt concrete overlay was placed in 1990.

The subgrade soils for Runway 09-27 are from the U.S.D.A. Tama-Ipava soil association (1). These soils are formed on nearly level to sloping terrain and are well drained to somewhat poorly drained.

On April 20, 1989 four soil borings to a depth of about 10 ft were conducted along the length of Runway 09-27. Figure 2 provides the grain size curves for typical soil samples from each of the four borings. Boring 1 was conducted at the West end of the runway near Station 219+00. Boring 2 was made at about Station 231+00, Boring 3 at about Station 244+00, and Boring 4 at the East end near Station 256+00. All borings were conducted near the centerline of the runway pavement.

Soils in the Tama-Ipava soil association are formed in loess and Figure 2 shows that the subgrade in Runway 09-27 is predominantly silt and clay materials. These soil materials would be classified in the range of A-4 through A-7 in the AASHTO system and in the range of ML through CL in the unified system.

The water table depth in the Tama-Ipava soil association can range from 1 ft to about 5 ft (1). In these soils the potential for frost action is high and the shrink-swell potential ranges from moderate to high. The soils are considered to be poor for use as subgrade materials.

INSTALLATION OF PREFABRICATED GEOCOMPOSITE SUBDRAINAGE SYSTEM

General

Because Runway 09-27 experienced recurring problems with differential frost heave and other water related distresses, it was determined by IDOA to install subdrainage during the Fall 1985. The pavement consisted of 8 in. of full-depth asphalt concrete placed directly on the subgrade and this created concern that the interface water between the pavement and subgrade would have difficulty reaching a pavement edge drain. For this reason construction was undertaken to insert longitudinal subdrain systems 12.5 ft on both sides of the runway centerline as well as along the pavement edges at 37.5 ft from the pavement centerline, Figure 3. In order to keep the disturbance of the installation trenches in the full depth asphalt concrete pavement at 12.5 ft from the centerline to a minimum it was proposed that narrow trench construction (4 in. wide) utilizing a PGS system be used. This procedure also provided improved possibility for an aircraft wheel to bridge the trench if any settlement occurred.

The PGS material selected for the Runway 09-27 subdrainage project consisted of a columnar polyethylene core, Figure 4, with a nonwoven geotextile wrap which was bonded to the columns and core backing, Figure 5. The material dimensions were nominally 1 in. wide by 18 in. deep. Roll length for the PGS material was 500 ft.

Installation Procedures and Equipment

A general discussion of the construction equipment and procedures for installing a PGS system can be found in work by Dempsey (2,3), Dempsey and Pur (4), and Hare, Pur, and Dempsey (5). An excellent design guide and installation manual for a PGS system has also been prepared by Monsanto (6).

Figure 6 shows the details for installation of the 18 in. PGS system at 12.5 ft from the pavement centerline. It is important to note that the top of the 18 in. PGS material should have extended above the bottom of the asphalt concrete pavement by 1 in. or more to improve interface drainage. Figure 7 shows the details for installation of the 6 in. diameter corrugated perforated polyethylene tubing at the edge of the runway pavement.

Figures 8, 9, and 10 show the installation process for the PGS material as it is placed 12.5 ft from the centerline of Runway 09-27. Figure 11 shows a typical transport trailer for distribution of the PGS material to a site. As shown in Figures 8, 9, and 10, the PGS material is installed immediately behind the trencher. The narrow 4 in. wide trench can be observed in Figure 10. As shown in Figure 12, the trench was backfilled with a porous type 2 envelope material, Table 1, which was later compacted to insure that settlement did not occur in the trench. An 8 in. deep asphalt concrete plug was then installed to complete the construction process.

The PGS system was connected to 4 in. diameter PVC outlet pipes at Sta 217+80, Sta 235+00, and Sta 257+20 in the runway. Although a conventional 6 in. diameter drainage pipe and sand envelope were used to construct the subdrainage system at the runway pavement edges, Figures 13, 14, and 15 show typical equipment which have been used on other airport subdrainage projects to install PGS materials at the same location. Essentially the construction sequence consists of trenching, installing the PGS material, backfilling the trench, and compacting the backfill. In most cases all of these operations can be accomplished in one pass if the trencher is fitted with the proper attachments, Figure 16.

Figures 17 and 18 show a method of using standard outlet fittings for interconnecting several GPS sections. It is important during construction to use the proper Tee outlets, end outlets, and end caps to insure that soils and materials cannot infiltrate through a hole into the GPS core. In most cases the Tee outlet and end outlet fittings are attached to a circular pipe which then carries water to a ditch or to a storm drain.

INSTRUMENTATION AND DATA COLLECTION

Subdrainage Outflow

One of the main objectives of this study was to evaluate the performance properties of the PGS system in Runway 09-27 in relation to precipitation events measured at the airport. Because of the lack of adequate elevation difference between the PGS system flow line and the outflow area a simple tipping bucket method could not be used (7). This problem was solved however by using a 5 1/2 in. deep, 3 11/16 in. wide, and 18 in. long metering flume produced by Sierra-Misco, Inc. A pipe end adapter was used to attach the metering flume to the 4 in. diameter outlet pipe from the PGS system. Figure 19 shows one of the metering flumes used on the runway. The metering flume utilizes a subsonic sensor to determine the depth of water flow in the flume. The flow depth data is recorded by a battery powered data logger at 3.6 minute intervals. The data logger is shown in Figure 19 sitting on top of the box shelter constructed for the metering flume. The battery life of the data logger is about 6 months. Outflow data is extracted from the data logger in the field by use of an Epson portable computer and then up-loaded to an IBM-AT computer using software provided by Sierra-Misco, Inc.

Two complete metering flumes with accompanying data loggers were placed to monitor outflow on Runway 09-27. One outflow monitoring system was placed on the North side of the runway at the outlet pipe located at station 235+00 (see Figure 1). The second outflow monitoring system was placed on the South side of the runway at the same station location. This location represents the low point in the vertical curve shown in Figure 1. The flow meters were connected only to the outlet pipes which drained the PGS systems installed 12.5 ft on either side of the centerline of the runway, Figure 20. The outflows from the subdrainage pipes at the outer edges of the runway were not monitored. The length of PGS system monitored at each outflow meter was about 3400 ft.

<u>Falling Weight Deflectometer</u>

Fall weight deflectometer (FWD) tests were conducted along the centerline of Runway 09-27 on June 17, 1987, April 18, 1988, and October 11, 1988. Each test was conducted at 100 ft intervals along the entire 3900 ft length of the runway. The FWD tests were conducted using a target load of 9000 lbs, falling weight drop of 3.0 ft, plate radius of 5.91 in., and detectors located at 0 in., 12 in., 24 in., and 36 in. from the plate center.

Appendix A shows the field data obtained from FWD Testing. The FWD stationing in Appendix A runs from the East end towards the West end of the runway. This is in reverse to the subdrainage stationing which started at the West end at Sta 218+00 and extended East 3900 ft to Sta 257+00.

Pavement Condition Index

Pavement Condition Index (PCI) ratings were conducted on Runway 09-27 in 1981, 1983, 1985, 1987, and 1990, Table 2. Each PCI survey was based on 15% to 20% of the entire area of the runway.

RESEARCH RESULTS AND DISCUSSION

Subdrainage Outflow Results

Outflows from the PGS system were monitored at 3.6 minute intervals from August 1, 1988 through December 31, 1988. The outflow flumes and data loggers were removed in January 1989 because of freezing water problems. Figures 21 and 22 show the outflows for both PGS systems on the North side and South side respectively of Runway 09-27. The precipitation rates given in in./hr. are also shown on these figures.

The outflow meters were reinstalled in April 1989. However the data were not logged because of low battery power in the data loggers. It was later learned that battery life for the data loggers was about 4 months.

Inspection of Figures 21 and 22 indicates that the PGS system was very responsive to rainfall events. In general outflow occurred within 1-or 2-hrs after start of rainfall. The outflow responses of both the North side and South side of the runway occurred at about the same time. However, there was a tendency for the outflow on the South side of the runway centerline to be greater than that on the North side. It is believed that most of the water which infiltrates the pavement reaches the PGS system by flowing along the interface between the subgrade and the full-depth asphalt concrete pavement.

The maximum outflow measured during the study period occurred at the South flow meter on August 23, 1988 and during the period of August 27 and 28, 1988. A peak outflow of over 1700 gal/hr was recorded during both of these rainfall periods. The flow meter on the North side registered an outflow of about 900 gal/hr for the same two time periods. It is interesting to note that the maximum rainfall intensity on August 23, 1988 was about 0.3 in./hr and that during the August 27 and 28, 1988 time period was about 0.4 in./hr.

Inspection of the pavement PGS system outflow data for Runway 09-27 indicates that outflow is not always directly related to rainfall intensity. The high intensity rainfall of 0.6 in./hr which occurred on September 19, 1988 provided for a maximum outflow of about 750 gal/hr on the North side and about 1050 gal/hr on the South side of the runway.

Based on the drained runway length of about 3400 ft (Sta 221+00 to Sta 255+00) and a drained width of 25 ft (distance between PGS systems) a total drainage area of 85,000 ft^2 of Runway 09-27 was monitored at the two outflow meters at Sta 235+00. From the amount of rainfall and the drainage area it is estimated from Figures 21 and 22 that 25% to over 45% of the rainfall water infiltrated the pavement and passed through the PGS systems. There was an indication that more rainfall water infiltrated the pavement in October and November than in August and September when the temperature was warmer and evaporation rates higher. Also the late fall infiltration could be greater because the asphalt pavement cracks would be more open in the colder months as a result of thermal contraction.

No attempts were made to measure the outflow from the 6 in. diameter corrugated perforated polyethylene tubing placed at the edges of Runway 09-27.

The airport manager indicated that, prior to installation of the subsurface drainage systems, water was often observed flowing from the cracks and construction joints in the runway pavement. This problem has not occurred since installation of the subdrainage systems.

Falling Weight Deflectometer Results

Table 3 shows the normalized deflection data results and estimated resilient moduli for the falling weight deflectometer (FWD) tests conducted at Runway 09-27 on June 17, 1987, April 18, 19898, and October 11, 1988. As noted previously, the test stationing is in reverse order to the subdrainage stationing which starts at the West end at Sta 218+00 and ends at the East end at Sta 257+00.

In Table 3, the deflection basin areas (AREA) are calculated as follows:

$$AREA = 6\ (D0 + 2\ D12 + 2\ D24 + D36)/D0 \qquad \text{(Eq. 1)}$$

The resilient moduli (Eri) for the 8 in. full depth asphalt concrete pavement on subgrade were determined in Table 3 by algorithms reported by Thompson (8) and Gomez and Thompson (9). These resilient moduli algorithms are as follows:

$$Eri = 24.7 - 5.41 * D36 + 0.31 * D36 * D36 \qquad \text{(Eq. 2)}$$

$$Log\ Eri = 2.87 - 0.13 * D36 - 1.2 * D36/D24 - 0.58 * Log(D0) \qquad \text{(Eq. 3)}$$

$$Log\ Eac = 1.731 - 1.046 * Log\ (D0 - D12) + 0.284 * (AREA/Tac) + 0.393 * D24/D36 + 0.012 * Tac \qquad \text{(Eq. 4)}$$

$$Log\ Eri = 10.193 - 3.238 * Log\ (D0) - 2.898 * Log\ (Tac) - 1.163 * Log\ (Eac) \qquad \text{(Eq. 5)}$$

$$Tac = 0.3 * AREA/(Log\ (Eac) - 5.28 - 0.105 * AREA + 3.52 * Log\ (AREA) + 0.98 * Log\ (D0)) \qquad \text{(Eq. 6)}$$

In Table 3 Eri (1) was determined from Eq. 2, Eri (2) from Eq. 3, and Eri (4) from Eq. 5. The algorithm for estimating the asphalt concrete stiffness, Eac, is listed as Eq. 4 and the back calculated asphalt concrete thickness, Tac, is determined from Eq. 6. In Eq. 1 through Eq. 6 and in Table 3 the terms are identified as follows:

DO = deflection at R = 0 in. from load (mils),

D12 = deflection at R = 12 in. from load (mils),

D24 = deflection at R = 24 in. from load (mils),

D36 = deflection at R = 36 in. from load (mils),

AREA = deflection basin area (in.),

Eri = resilient modulus, (ksi),

Eac = asphalt concrete stiffness (ksi), and

Tac = thickness of asphalt concrete (in.).

Figure 23 provides a comparison between maximum measured FWD deflections, DO, on the different testing dates. Figure 23 shows that the maximum deflections decreased from June 17, 1987 to October 11, 1988. Figures 24, 25, and 26 show the subgrade Eri values estimated from the FWD data. Figure 24 was developed from Eri (1) data in Table 3 as determined from Eq. 2. Similarly Figure 25 was developed from Eri (2) data utilizing Eq. 3 and Figure 26 was developed from Eri (4) data utilizing Eq. 5. Figures 24, 25, and 26 all showed that the subgrade beneath Runway 09-27 is very weak and ranges from less than 1 ksi to generally 3 ksi. It is felt that Figure 26 provides the best estimate of the subgrade Eri for the runway since it is based on the influence of asphalt concrete stiffness and thickness as well as deflection data. Figures 23 through 26 would indicate that there was some decrease in maximum deflection and improvement in Eri for the time period from June 17, 1987 to October 11, 1988.

In analyzing the FWD data it is difficult to determine whether the changes noted are caused mainly by climatic factors or by the influence of improved subsurface drainage. It is felt that a longer testing period would have been needed to arrive at a definite conclusion. One interesting note in Table 3 is the fact that back calculated asphalt concrete pavement thicknesses, Tac, are often times 3 in. to 4 in. less than the constructed value of 8 in. This indicates that the bottom half of the full depth asphalt concrete pavement may not be well bonded.

Pavement Condition Results

Figure 27 shows the PCI values for Runway 09-27 during the time period from 1981 to 1990. The 1987 and 1990 PCI values represent those determined after the subdrainage systems were installed in 1985 and prior to the asphalt concrete overlay placed during the summer of 1990.

The distress types observed in Runway 09-27 are listed in Table 4. Of the distress types listed in Table 4, longitudinal and transverse cracking and paving construction joints were the most prevalent.

Figure 27 indicates that the PCI for Runway 09-27 ranged from a low of 76 to a high of 85. This range of values falls into an overall rating of very good. The PCI ratings obtained after 1985 indicate that some overall improvement in pavement performance may have resulted from the subdrainage installation.

Kewanee Municipal Airport is a low volume general aviation airport with a majority of aircraft operating at considerably less than the 12,500 lb design load. There was little evidence of fatigue damage and no observed block cracking often associated with frost damage. The main distresses were longitudinal and transverse cracking which is primarily caused by thermal stresses in the asphalt concrete.

An important observation in the post subdrainage installation PCI evaluations was that there was very little evidence of any settlement in the asphalt concrete plug placed back into the 4 in. wide cut made to install the PGS system 12.5 ft on either side of the runway centerline. Figures 28 and 29 show the good condition of the asphalt concrete plug approximately three years after installation of the PGS system. It was felt that the in-runway installation of the PGS system did not create any safety hazards to aircraft operating on the runway pavement.

A second major observation was that although frost heave had been a problem prior to installation of the subsurface drainage systems both the pavement condition studies and the airport manager indicated that no serious differential frost heave problems had occurred since subdrainage installation.

In January 1993 a visual inspection of the entire 4500 ft length of Runway 09-27 was conducted. Except for two full width cracks in the 3 in. overlay where Runway 09-27 intersected the outer edges of Runway 01-19 only 36 ft of random cracking was observed. There were no longitudinal cracks or distresses observed in the overlay at the locations of the PGS system 12.5 ft on either side of the centerline of Runway 09-27. Inspection of the PGS system outlets indicated that water was flowing from the subdrainage systems.

SUMMARY

The PGS system has performed very well since its installation in 1985. This study demonstrated that a PGS system could be installed within the active runway area at a distance of 12.5 ft on either side of the centerline. There were no problems with settlement or distresses along the installation location.

Subdrainage outflow measurements indicated that 25% to 45% of the rainfall water infiltrated the pavement and passed through the PGS system. Subdrainage outflows varied but a maximum outflow of over 1700 gal/hr was measured during the study. It was observed that water flow from the pavement joints and cracks ceased once the PGS system was installed.

The FWD data indicated that the subgrade soil beneath Runway 09-27 ranged from less than 1 ksi to generally 3 ksi. Although there was some improvement in subgrade strength during the study period it was not possible to conclude that subdrainage was totally responsible for this improvement. There was an indication from the data analysis that there could be some loss of bond in the lower half of the full-depth asphalt concrete layer.

The PCI study conducted on Runway 09-27 provided results from 1981 to 1990. The PCI ratings obtained after installation of the PGS system in 1985 indicated the possibility of some overall improvement in pavement performance. Visual observations indicated that surface seepage of water and differential frost heave problems did not occur again after installation of subdrainage. Visual inspection in January 1993 indicated there was no evidence of longitudinal reflective cracking in the 3 in. asphalt concrete overlay, that was placed during the summer 1990, in the area above the PGS system.

It would appear that the PGS system is functioning properly and that Runway 09-27 at Kewanee Municipal Airport is continuing to perform very well. It is felt that the PGS system was successful in reducing the influence of differential frost heave and water related distresses in the runway.

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Table 1

Porous Type 2 Envelope

Material Specification

Sieve Size	Percent Passing
1 1/2"	100
1"	90-100
3/8"	25-60
#4	5-40
#8	0-20

Table 2

Pavement Condition Index (PCI) Values for

Kewanee Municipal Airport Runway 09-27

Year	PCI
1981	85.6
1983	76.1
1985	79.4
1987	82.2
1990	78.8

Table 3

Normalized Deflection Data and Estimated Resilient Moduli

from FWD Tests Conducted on Runway 09-27 at Kewanee Municipal Airport

Kewanee Airport Deflection Data
June 17, 1987

Test	Sta +00	D0 mils	D12 mils	D24 mils	D36 mils	AREA in	Eri(1) ksi	Eri(2) ksi	Eac(3) ksi	Eri(4) ksi	Tac(5) in
1	255	61.08	34.14	16.74	7.39	16.72	1.6	2.2	65	0.5	4.9
2	254	87.83	42.23	17.40	7.00	14.63	2.0	2.2	39	0.3	3.7
3	253	78.94	42.06	18.71	7.69	15.82	1.4	1.9	51	0.3	4.2
4	252	94.52	49.20	20.90	7.88	15.40	1.3	1.8	48	0.2	3.8
5	251	99.80	49.28	18.57	6.51	14.55	2.6	2.8	48	0.1	3.5
6	250	91.38	48.78	20.63	7.76	15.62	1.4	1.9	53	0.2	3.9
7	249	93.98	49.53	20.78	7.78	15.47	1.4	1.8	50	0.2	3.8
8	248	117.95	58.99	21.96	8.07	14.65	1.2	1.5	37	0.1	3.3
9	247	105.51	54.47	22.00	8.33	15.17	1.1	1.4	41	0.1	3.6
10	246	82.81	43.78	18.59	7.39	15.57	1.6	2.1	51	0.2	4.0
11	245	128.29	54.57	20.04	6.71	13.29	2.4	2.4	33	0.1	3.0
12	244	105.26	49.58	19.66	7.65	14.33	1.5	1.7	33	0.2	3.4
13	243	94.71	50.70	21.53	8.36	15.68	1.1	1.5	47	0.2	3.9
14	242	96.94	48.96	19.55	7.45	14.94	1.6	2.0	43	0.2	3.6
15	241	98.84	49.80	20.21	8.03	14.99	1.2	1.6	38	0.2	3.6
16	240	86.11	44.57	18.67	7.47	15.33	1.6	2.0	46	0.2	3.9
17	239	97.64	47.98	18.76	6.62	14.61	2.5	2.7	48	0.1	3.5
18	238	80.99	43.79	19.62	8.46	16.02	1.1	1.4	46	0.3	4.2
19	237	85.31	46.42	20.83	8.92	16.09	1.1	1.2	45	0.3	4.1
20	236	102.46	54.09	22.04	8.49	15.41	1.1	1.4	43	0.1	3.7
21	235	95.60	48.04	19.41	7.54	14.94	1.5	1.9	41	0.2	3.7
22	234	117.83	59.68	23.50	8.60	14.91	1.1	1.3	38	0.1	3.4
23	233	87.67	45.88	18.95	7.30	15.37	1.7	2.1	50	0.2	3.9
24	232	81.63	44.49	19.89	8.42	16.08	1.1	1.4	48	0.3	4.2
25	231	86.61	44.14	19.56	9.05	15.45	1.1	1.0	33	0.3	3.9
26	230	61.37	34.88	16.26	7.42	16.73	1.6	2.1	62	0.5	4.9
27	229	69.66	37.40	16.52	7.25	15.91	1.8	2.1	51	0.4	4.4
28	228	66.74	37.48	16.91	7.17	16.42	1.8	2.3	64	0.4	4.6
29	227	77.70	40.89	16.72	6.98	15.44	2.0	2.3	48	0.3	4.1
30	226	70.57	41.13	18.61	7.86	16.83	1.3	1.9	66	0.3	4.7
31	225	55.83	31.05	12.87	6.20	16.11	3.1	3.0	57	0.8	4.9
32	224	25.18	16.84	10.15	6.13	20.32	3.2	3.4	172	2.7	10.8
33	223	60.05	35.77	18.22	7.98	17.59	1.3	1.9	79	0.4	5.3
34	222	47.62	30.30	15.96	8.10	18.68	1.2	1.7	93	0.7	6.4
35	221	53.94	34.50	18.14	8.91	18.70	1.1	1.3	88	0.5	6.0
36	220	45.64	28.97	15.52	7.80	18.72	1.4	2.0	99	0.8	6.5
37	219	52.44	32.76	16.90	8.26	18.31	1.2	1.6	85	0.6	5.9
38	218	47.19	30.96	17.23	8.90	19.39	1.1	1.3	102	0.7	6.8

*(1) Eri = 24.7-5.41*D36+0.31*D36*D36*

*(2) Log Eri = 2.87-0.13*D36-1.2*D36/D24-0.58*Log(D0)*

*(3) Log Eac = 1.731-1.046*Log(D0-D12)+0.284*(AREA/Tac)+0.393*D24/D36+0.012*Tac*

*(4) Log Eri = 10.193-3.238*Log(D0)-2.898*Log(Tac)-1.163*Log(Eac)*

*(5) Tac = 0.3*AREA/(Log(Eac)-5.28-0.105*AREA+3.52*Log(AREA)+0.98*Log(D0))*

Table 3 Continued

Kewanee Airport Deflection Data
April 18, 1988

FWD Test	Sta +00	D0 mils	D12 mils	D24 mils	D36 mils	AREA in	Eri(1) ksi	Eri(2) ksi	Eac(3) ksi	Eri(4) ksi	Tac(5) in
1	256	29.33	20.87	13.65	8.27	21.82	1.2	1.6	190	1.5	5.1
2	255	36.05	24.85	15.29	8.51	20.78	1.1	1.6	149	1.0	4.4
3	254	30.43	22.48	14.72	8.58	22.36	1.1	1.6	225	1.1	5.3
4	253	37.42	25.38	15.98	9.18	20.74	1.2	1.2	131	1.0	4.4
5	252	49.79	31.71	18.47	9.45	19.23	1.3	1.1	92	0.6	3.6
6	251	42.57	28.92	17.67	9.63	20.49	1.3	1.0	123	0.7	4.2
7	250	39.48	27.79	17.52	9.75	21.25	1.4	1.0	148	0.8	4.5
8	249	42.20	29.37	18.00	9.80	20.86	1.5	1.0	135	0.7	4.3
9	248	41.61	28.27	17.08	9.34	20.43	1.2	1.2	124	0.8	4.2
10	247	39.66	27.51	16.83	9.32	20.83	1.2	1.2	139	0.8	4.3
11	246	56.57	38.50	22.34	11.62	20.14	3.7	0.5	96	0.4	3.7
12	245	42.54	29.45	17.70	9.58	20.65	1.3	1.1	131	0.7	4.2
13	244	51.77	31.67	17.90	9.10	18.55	1.1	1.2	79	0.7	3.4
14	243	40.99	28.88	17.67	9.63	21.04	1.3	1.1	145	0.7	4.4
15	242	38.49	26.23	16.34	9.29	20.72	1.2	1.1	130	1.0	4.3
16	241	40.39	27.48	16.71	9.27	20.50	1.2	1.2	126	0.9	4.2
17	240	47.02	30.63	18.00	9.36	19.61	1.2	1.1	102	0.7	3.8
18	239	33.71	23.50	15.10	8.85	21.32	1.1	1.3	158	1.2	4.7
19	238	35.96	26.08	15.90	8.87	21.49	1.1	1.4	180	0.8	4.7
20	237	39.68	28.17	17.72	10.03	21.40	1.6	0.9	148	0.8	4.5
21	236	35.90	24.25	15.25	8.81	20.67	1.1	1.3	134	1.2	4.4
22	235	49.80	32.35	18.91	10.01	19.56	1.6	0.9	92	0.6	3.7
23	234	40.98	27.96	17.02	9.32	20.54	1.2	1.2	128	0.8	4.2
24	233	39.53	28.16	17.65	10.24	21.46	1.8	0.8	145	0.8	4.5
25	232	37.86	24.39	14.92	8.68	19.83	1.1	1.3	106	1.3	4.1
26	231	36.14	25.52	15.85	9.14	21.25	1.1	1.2	155	1.0	4.6
27	230	31.67	22.30	14.20	8.32	21.41	1.1	1.6	174	1.3	4.8
28	229	35.93	24.71	15.26	8.74	20.81	1.1	1.4	142	1.1	4.5
29	228	41.28	27.54	16.04	8.72	19.94	1.1	1.4	117	0.9	4.0
30	227	38.08	27.19	16.72	9.44	21.33	1.3	1.1	157	0.8	4.5
31	226	36.12	25.43	15.82	9.00	21.20	1.1	1.3	156	1.0	4.6
32	225	32.34	22.75	13.80	7.97	21.04	1.3	1.8	169	1.2	4.7
33	224	18.60	14.16	9.95	6.55	23.67	2.6	3.1	387	2.9	7.0
34	223	22.26	17.25	12.06	7.87	23.92	1.3	1.9	352	1.8	6.6
35	222	22.63	18.16	13.11	8.71	24.89	1.1	1.4	419	1.4	7.1
36	221	20.63	16.62	11.98	8.09	24.99	1.2	1.8	463	1.7	7.5
37	220	20.85	16.80	12.23	8.32	25.10	1.1	1.6	457	1.6	7.5
38	219	17.46	14.21	10.41	7.16	25.38	1.9	2.5	581	2.2	8.3
39	218	25.14	19.46	13.47	8.68	23.79	1.1	1.4	310	1.4	6.3

*(1) Eri = 24.7-5.41*D36+0.31*D36*D36*
*(2) Log Eri = 2.87-0.13*D36-1.2*D36/D24-0.58*Log(D0)*
*(3) Log Eac = 1.731-1.046*Log(D0-D12)+0.284*(AREA/Tac)+0.393*D24/D36+0.012*Tac*
*(4) Log Eri = 10.193-3.238*Log(D0)-2.898*Log(Tac)-1.163*Log(Eac)*
*(5) Tac = 0.3*AREA/(Log(Eac)-5.28-0.105*AREA+3.52*Log(AREA)+0.98*Log(D0))*

Table 3 Continued

Kewanee Airport Deflection Data
October 11, 1988

Test	Sta +00	D0 mils	D12 mils	D24 mils	D36 mils	AREA in	Eri(1) ksi	Eri(2) ksi	Eac(3) ksi	Eri(4) ksi	Tac(5) in
1	256	19.55	13.99	9.42	6.08	22.24	3.3	3.6	279	3.6	5.7
2	255	26.20	16.62	10.03	5.91	19.56	3.6	3.7	145	2.9	4.3
3	254	20.49	14.25	9.06	5.60	21.29	4.1	4.4	244	3.6	5.2
4	253	27.00	18.72	11.52	6.64	20.92	2.4	3.1	196	1.9	4.6
5	252	32.29	21.39	12.08	6.59	19.66	2.5	3.C	145	1.5	4.0
6	251	28.22	19.43	11.73	6.79	20.70	2.3	2.8	179	1.8	4.5
7	250	34.13	22.15	11.91	6.13	19.05	3.2	3.7	138	1.3	3.8
8	249	36.92	24.60	13.74	7.14	19.62	1.9	2.6	138	1.0	3.9
9	248	29.13	19.50	11.59	6.79	20.21	2.3	2.7	153	2.0	4.3
10	247	26.71	19.19	11.86	7.07	21.54	1.9	2.6	216	1.7	4.9
11	246	38.91	24.50	12.78	6.64	18.52	2.4	2.9	107	1.2	3.5
12	245	35.42	22.07	13.23	7.53	19.24	1.5	2.0	105	1.6	3.8
13	244	29.29	18.99	11.36	6.62	19.79	2.5	2.9	139	2.2	4.2
14	243	27.97	20.35	12.65	7.36	21.74	1.7	2.4	225	1.4	4.9
15	242	28.76	19.58	11.79	6.88	20.52	2.2	2.7	167	1.9	4.4
16	241	29.58	20.29	12.21	7.17	20.64	1.8	2.4	165	1.7	4.4
17	240	29.43	19.97	11.89	6.82	20.39	2.2	2.8	164	1.8	4.4
18	239	23.53	17.26	10.94	6.76	22.10	2.3	2.8	259	2.1	5.3
19	238	24.01	16.97	10.70	6.49	21.45	2.6	3.2	224	2.4	5.0
20	237	35.65	23.98	14.11	7.96	20.16	1.3	1.8	133	1.2	4.0
21	236	25.81	17.47	10.94	6.53	20.73	2.6	3.1	181	2.4	4.6
22	235	40.60	26.34	14.83	8.16	19.37	1.2	1.6	105	1.0	3.7
23	234	27.90	20.23	12.59	7.41	21.71	1.6	2.3	219	1.5	4.9
24	233	29.06	20.73	12.94	7.67	21.49	1.4	2.1	195	1.5	4.7
25	232	29.35	19.83	12.10	7.32	20.55	1.7	2.2	152	1.9	4.4
26	231	27.83	19.33	12.03	7.33	21.11	1.7	2.2	177	1.9	4.7
27	230	24.61	17.72	11.40	6.93	21.89	2.1	2.7	236	2.0	5.1
28	229	24.66	17.96	11.34	6.93	21.94	2.1	2.7	243	2.0	5.1
29	228	32.15	21.92	12.37	7.08	20.12	1.9	2.4	148	1.5	4.2
30	227	29.16	20.36	12.21	7.21	20.89	1.8	2.4	176	1.7	4.5
31	226	25.74	18.97	12.29	7.58	22.35	1.5	2.1	245	1.7	5.2
32	225	20.90	15.51	9.96	6.34	22.44	2.9	3.3	299	2.6	5.7
33	224	12.74	9.97	7.13	5.02	24.47	5.4	5.4	618	5.6	8.2
34	223	15.90	12.77	9.08	6.18	24.83	3.1	3.6	586	2.9	7.6
35	222	18.05	14.39	10.29	6.97	24.73	2.0	2.6	497	2.4	7.2
36	221	16.25	12.77	9.15	6.16	24.47	3.1	3.6	517	3.2	7.3
37	220	16.21	12.99	9.35	6.49	24.93	2.6	3.1	557	2.9	7.6
38	219	15.76	12.60	9.14	6.32	24.96	2.9	3.3	574	3.1	7.7
39	218	20.02	15.74	11.04	7.43	24.27	1.6	2.2	408	2.1	6.6

*(1) Eri = 24.7-5.41*D36+0.31*D36*D36*

*(2) Log Eri = 2.87-0.13*D36-1.2*D36/D24-0.58*Log(D0)*

*(3) Log Eac = 1.731-1.046*Log(D0-D12)+0.284*(AREA/Tac)+0.393*D24/D36+0.012*Tac*

*(4) Log Eri = 10.193-3.238*Log(D0)-2.898*Log(Tac)-1.163*Log(Eac)*

*(5) Tac = 0.3*AREA/(Log(Eac)-5.28-0.105*AREA+3.52*Log(AREA)+0.98*Log(D0))*

Table 4

Distress Types Observed in

Runway 09-27 at Kewanee Municipal Airport

Alligator Cracking

Bleeding

Longitudinal and Transverse Cracking

Paving Lane Joints

Depressions

Patching

Slippage Cracking

Raveling and Weathering

Oil Spillage

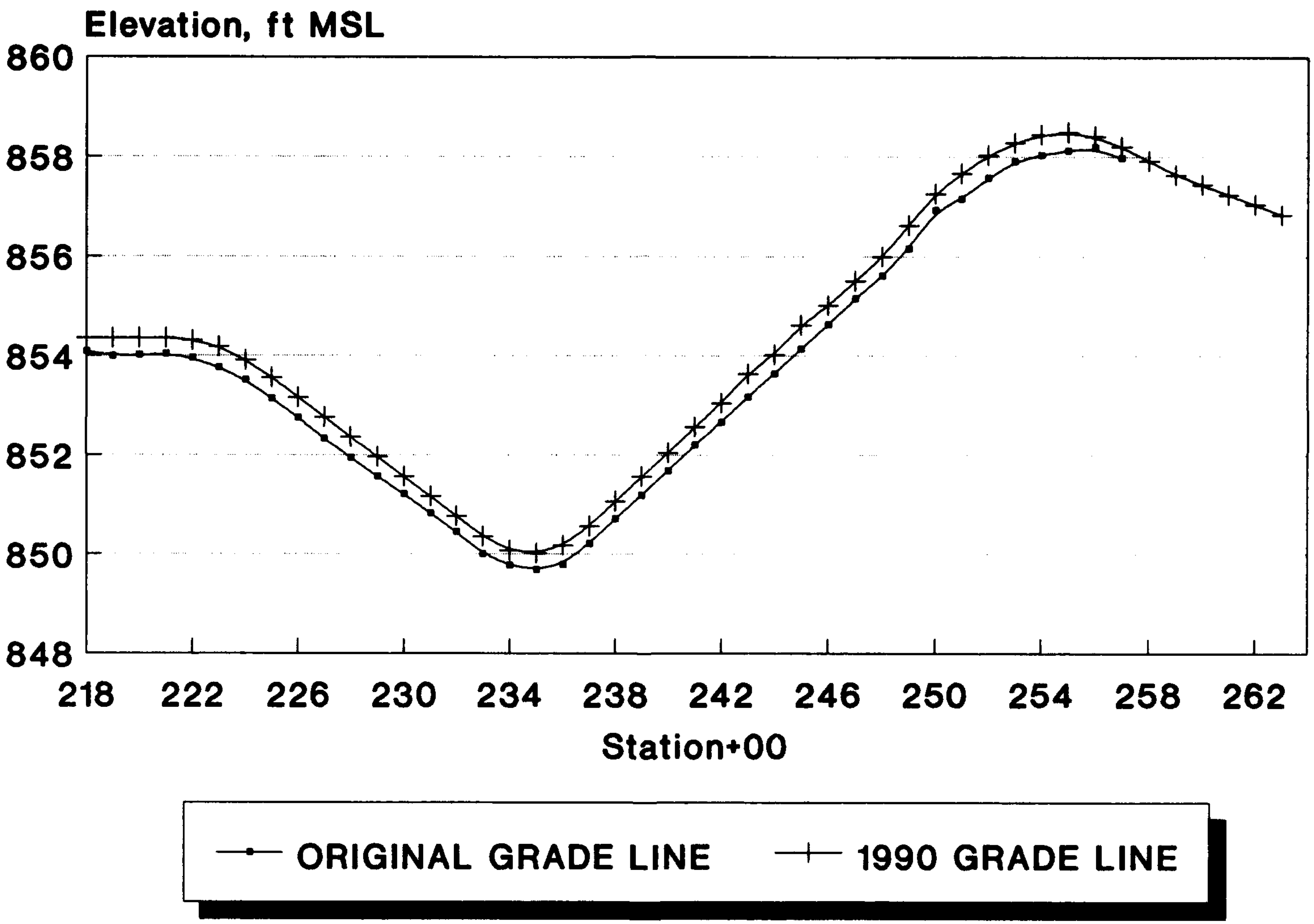

Figure 1. Longitudinal Gradient for the Centerline of Runway 09-27 at Kewanee Municipal Airport.

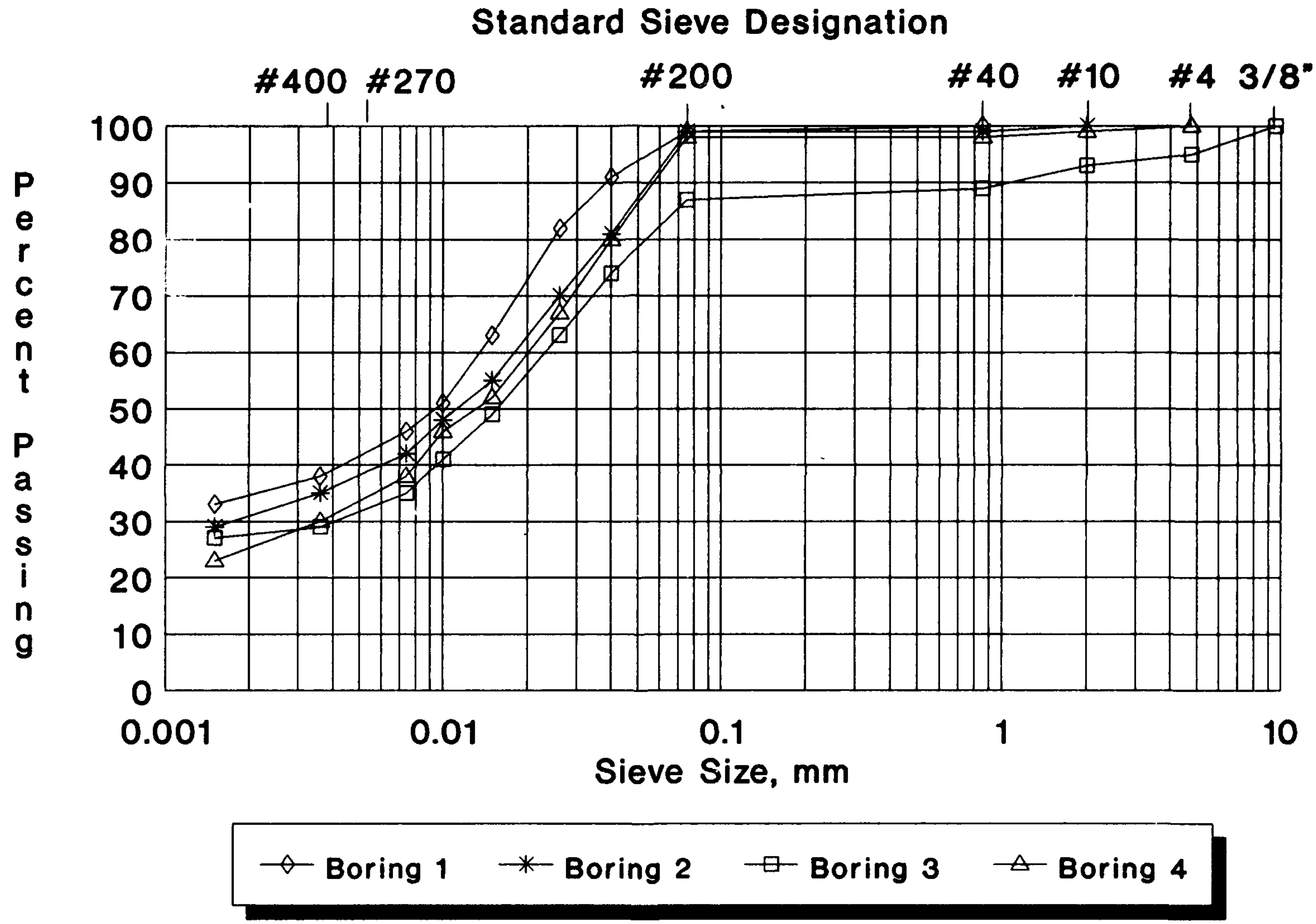

Figure 2. Grain Size Curves for Subgrade Soils in Runway 09-27.

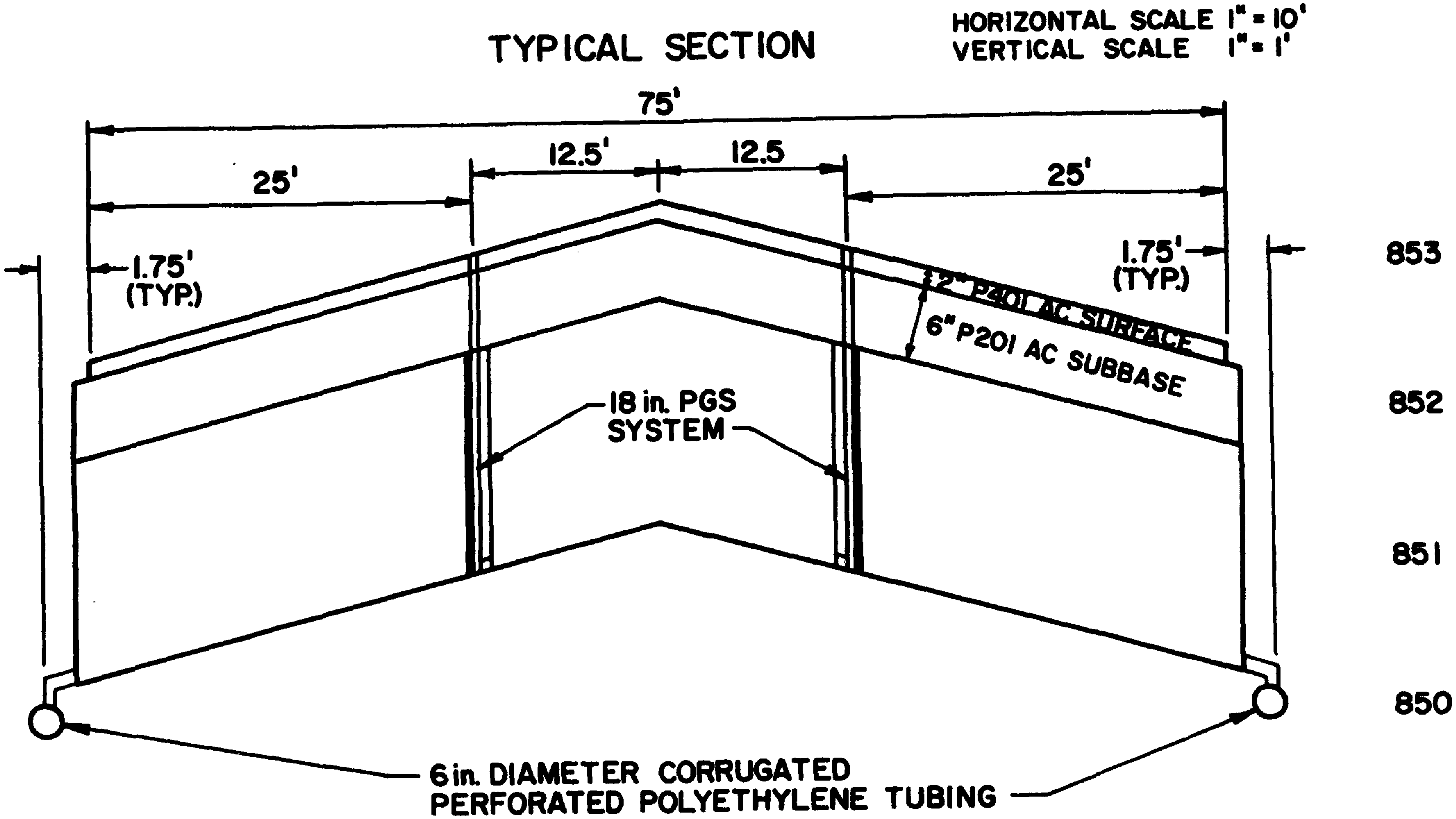

Figure 3. Locations of Longitudinal Subdrainage Systems in Runway 09-27.

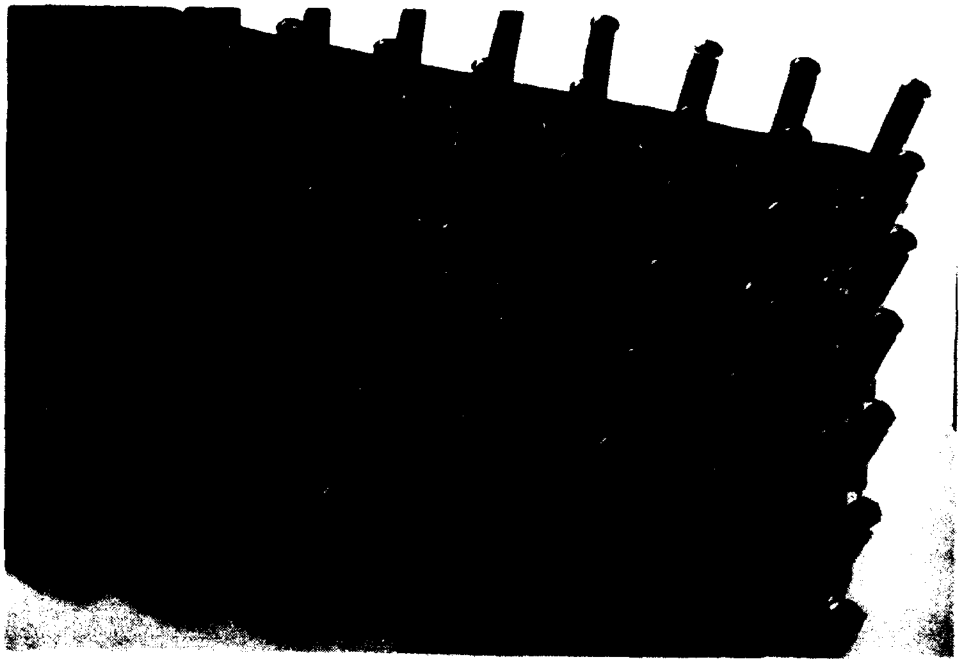

Figure 4. Columnar Polyethylene Core of PGS Material Used in Runway 09-27.

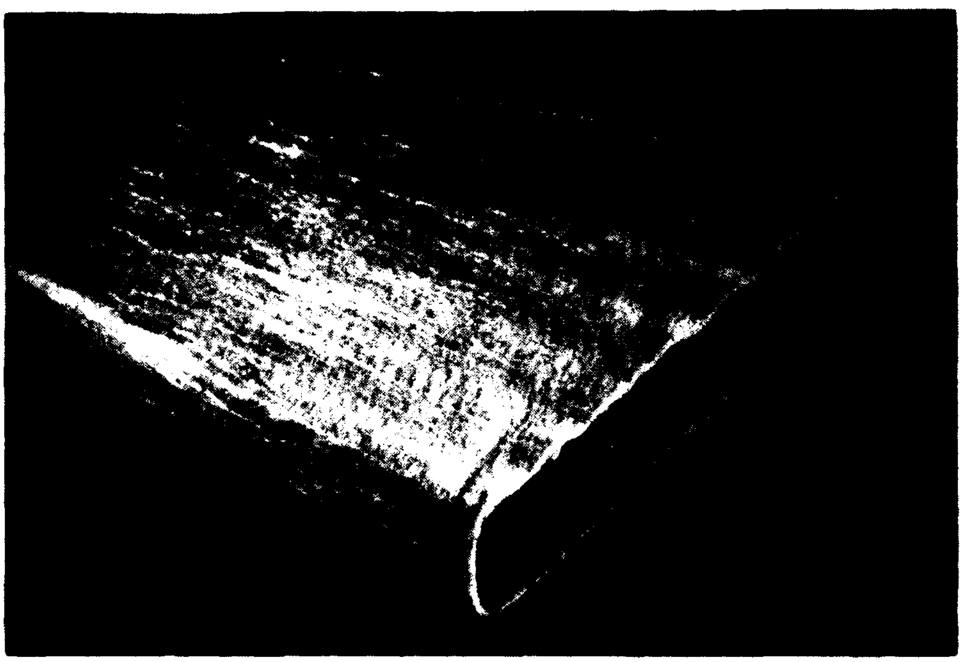

Figure 5. Completed PGS Material Used in Runway 09-27.

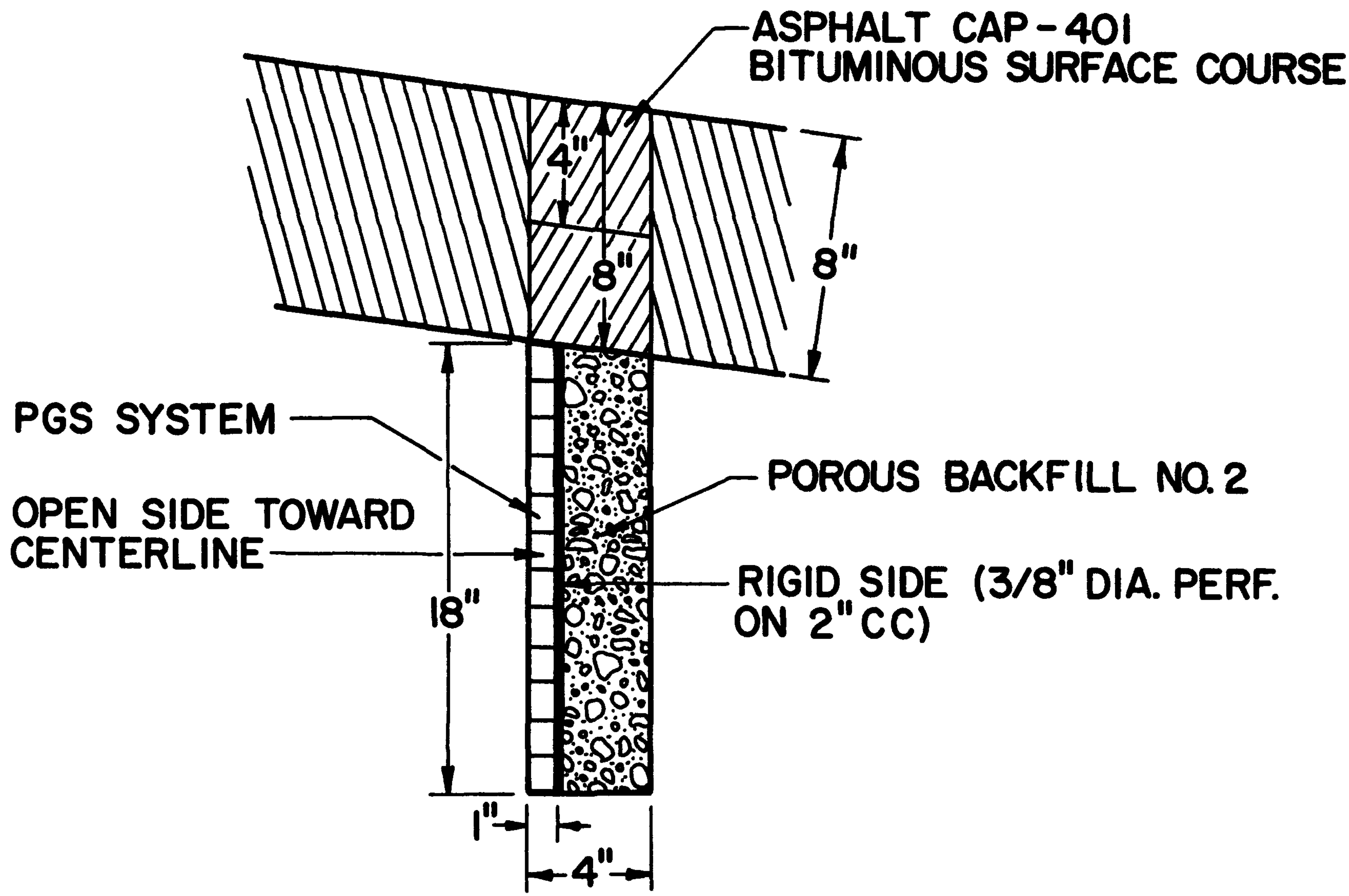

Figure 6. Installation Details of 18 in. PGS System in Runway 09-27.

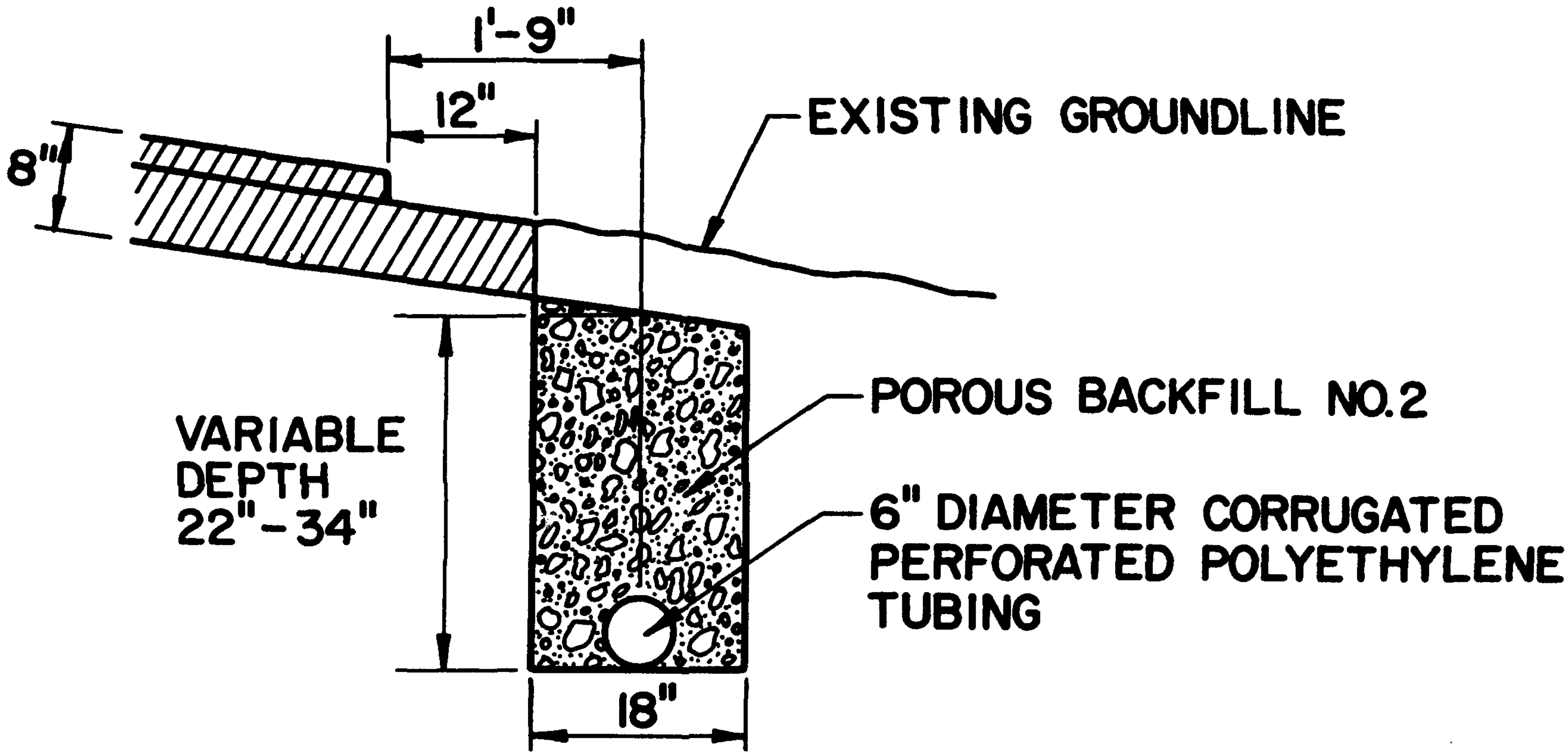

Figure 7. Installation Details for 6 in. Diameter Corrugated Perforated Polyethylene Tubing at the Edge of Runway 09-27.

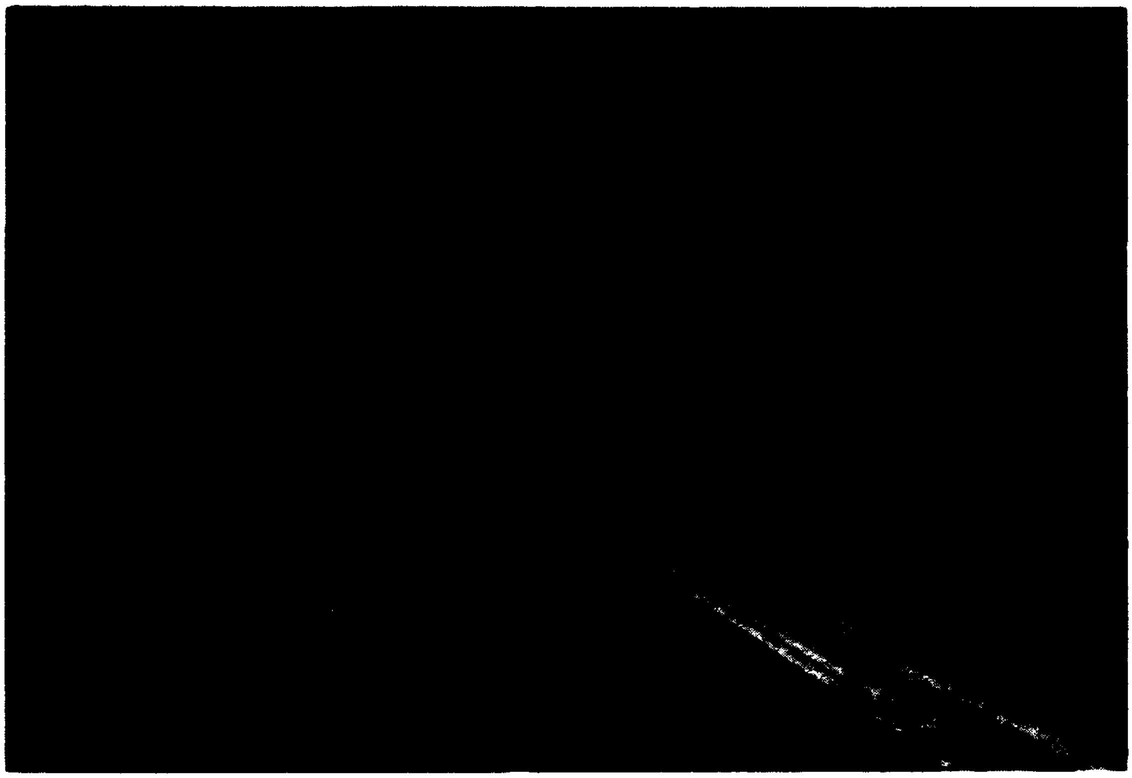

Figure 8. Installation of PGS System at 12.5 ft from Runway 09-27 Centerline.

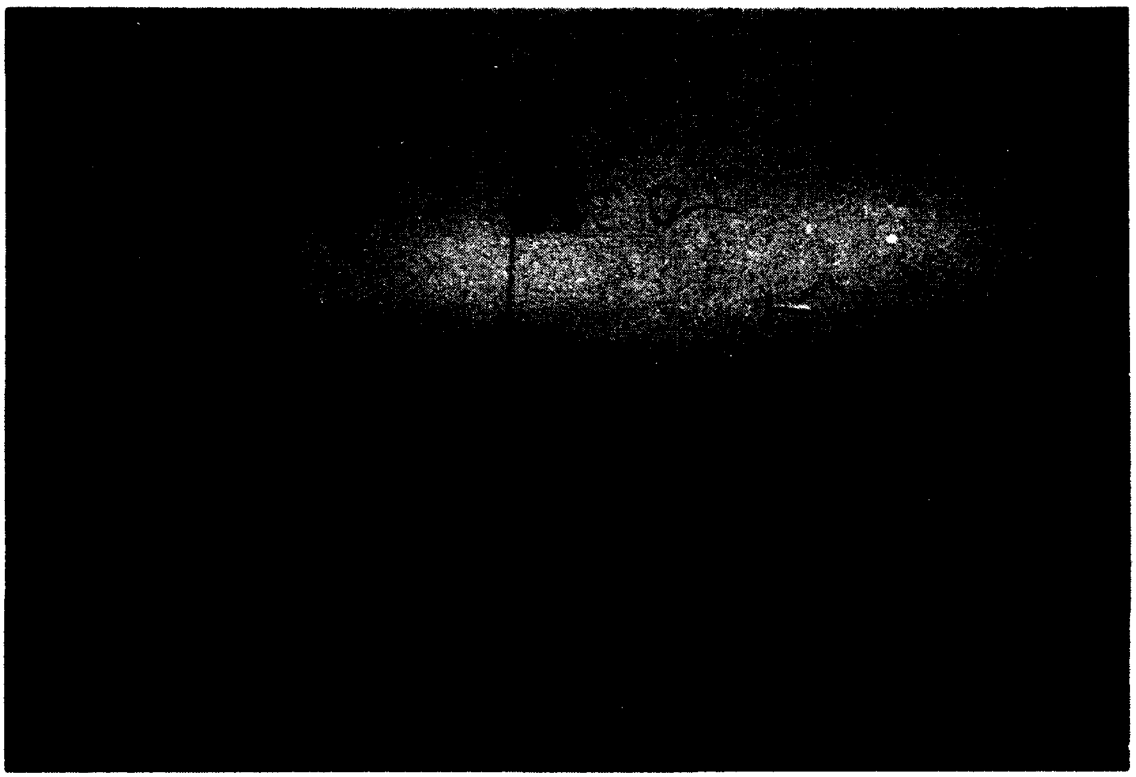

Figure 9. PGS System Installation.

Figure 10. Installat.on of PGS System Showing Narrow Trench Construction.

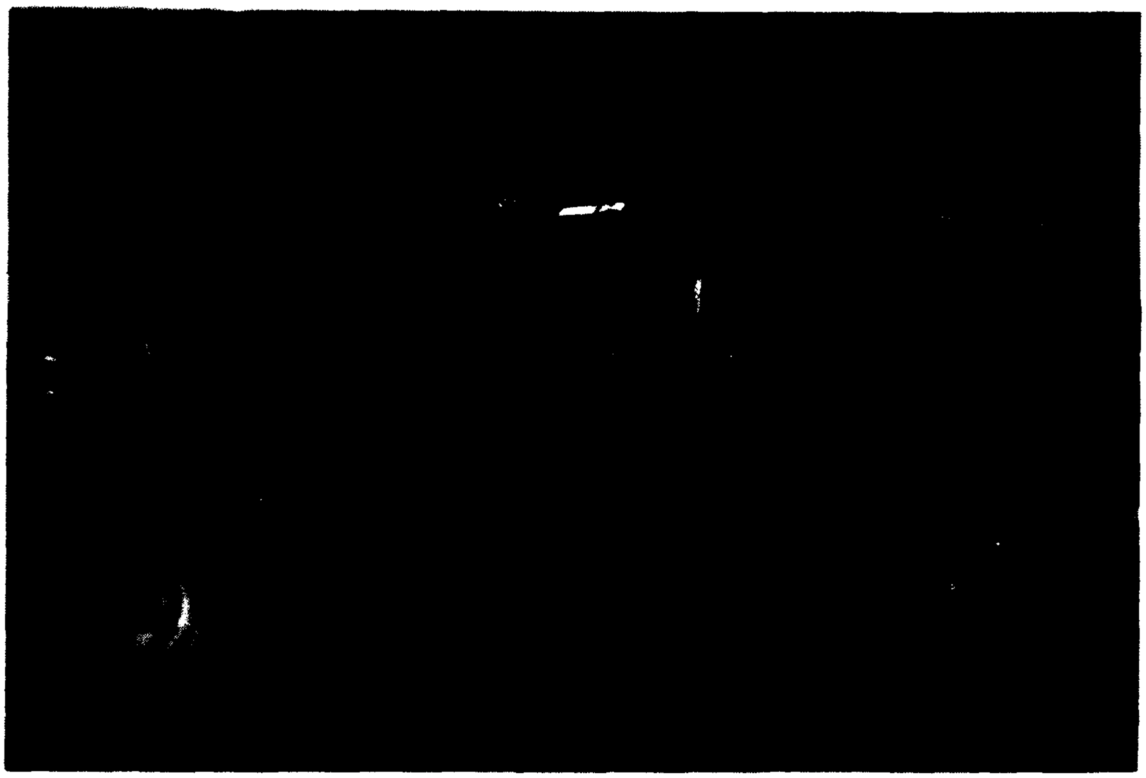

Figure 11. Transport Trailer for PGS Materials.

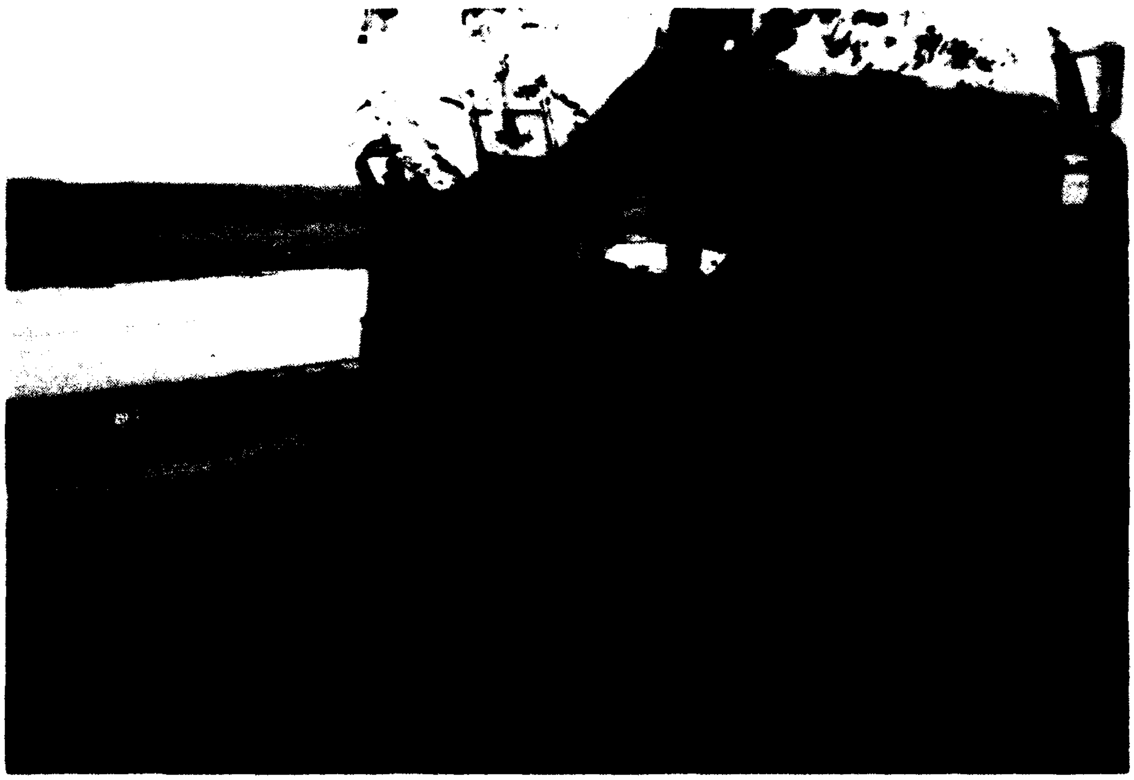

Figure 12. Placement of Type 2 Porous Backfill in PGS System Trench.

Figure 13. Small Chain Trencher Working Along Runway Edge.

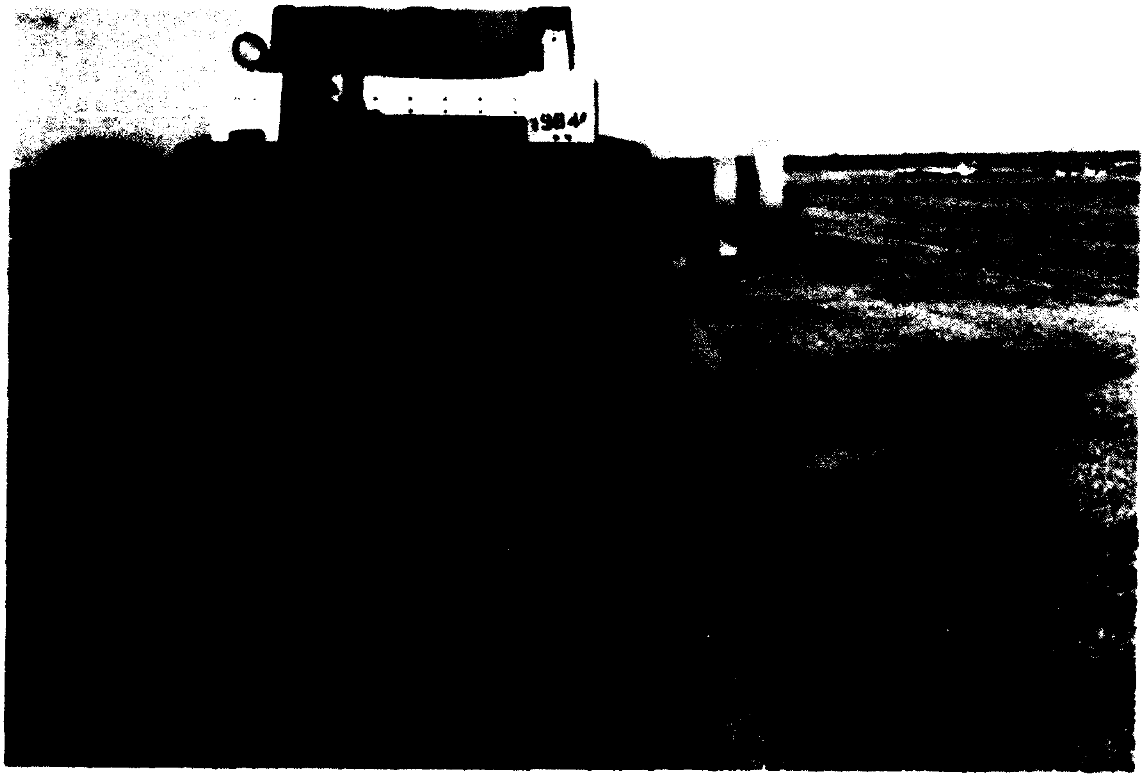

Figure 14. Tractor Mounted PGS Material Installation and Backfill Equipment.

Figure 15. High Speed Wheel Trencher Installing PGS Material.

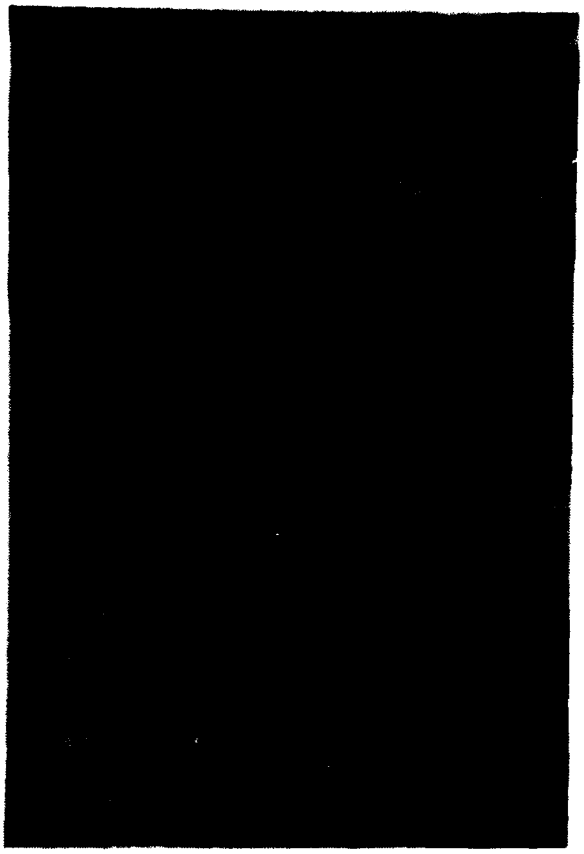

Figure 16. Trencher Attachment for Installing and Backfilling a PGS System in One Operation.

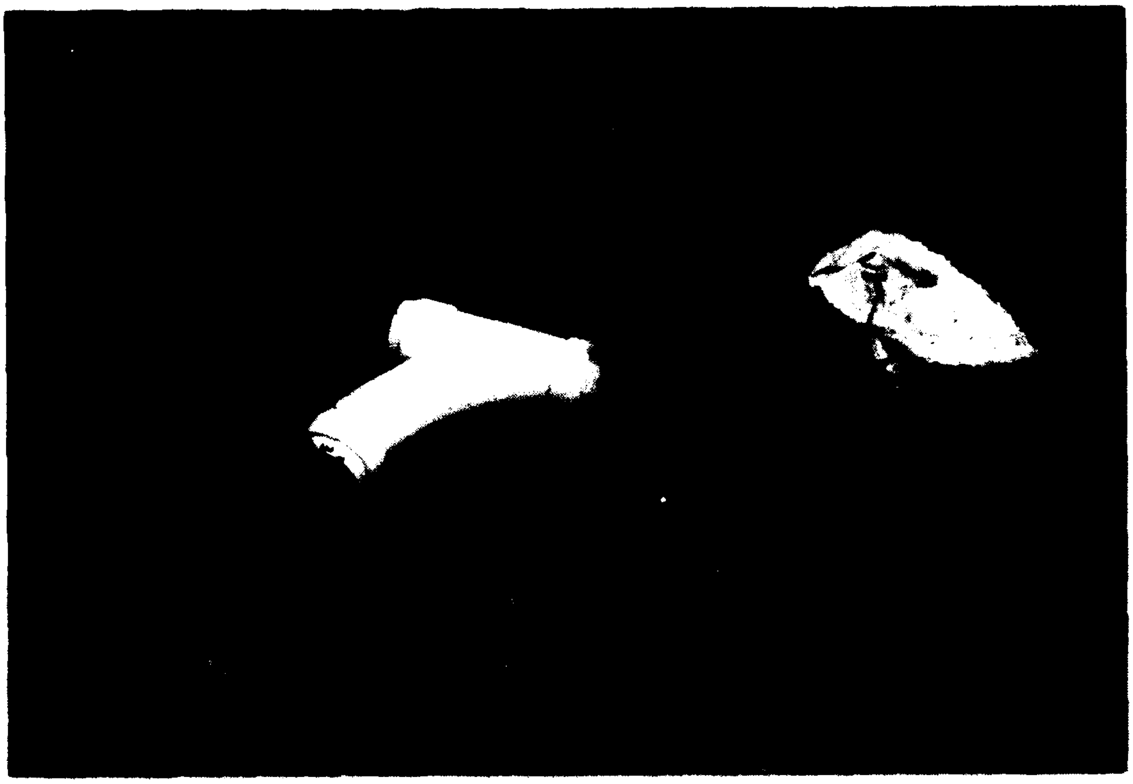

Figure 17. Method for Connecting Several PGS Systems Together.

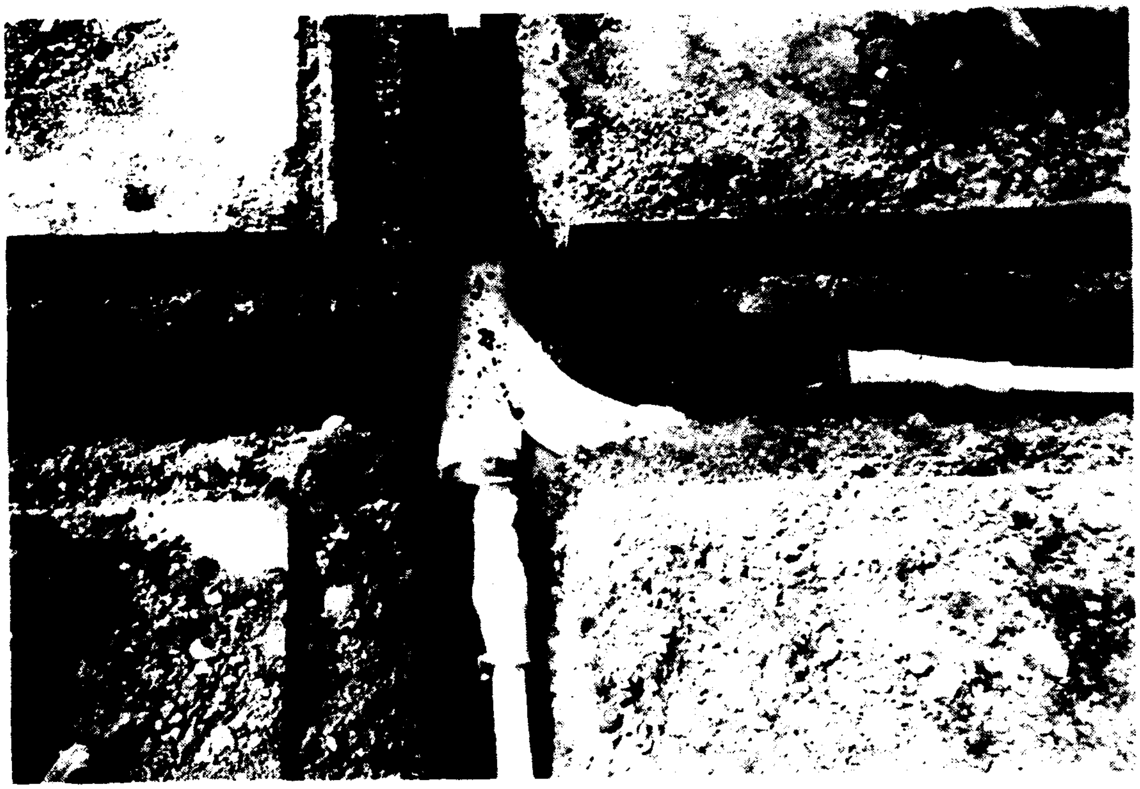

Figure 18. Interconnection of Several PGS Systems in a Trench.

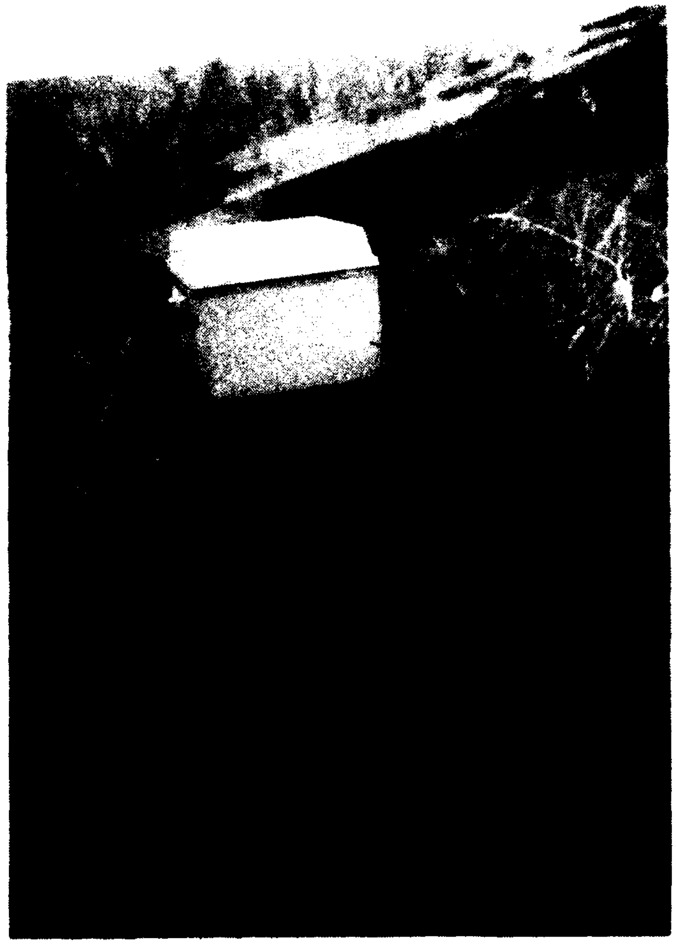

Figure 19. Outflow Metering Flume and Data Logger at Kewanee Municipal Airport.

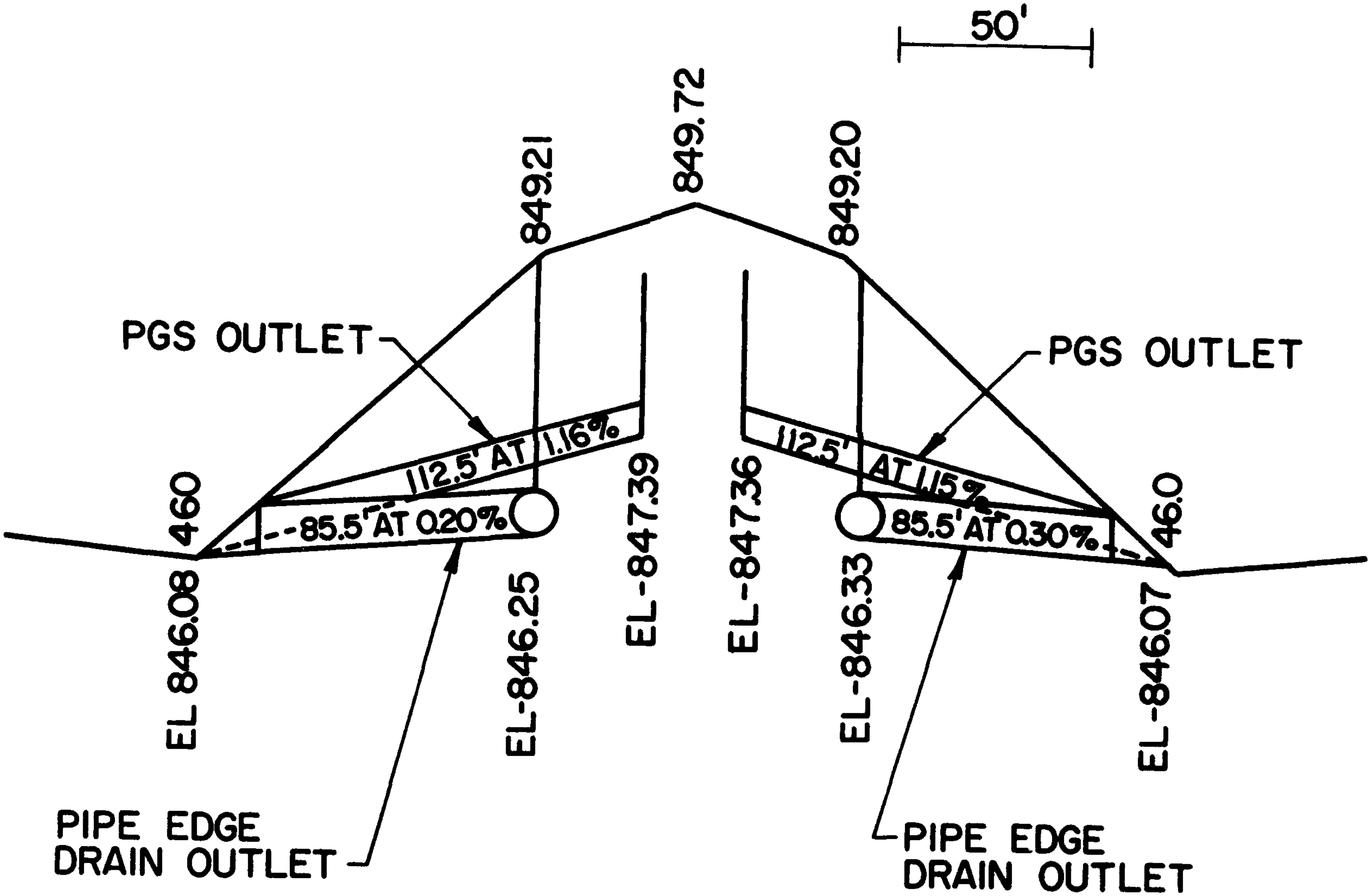

Figure 20. Drainage Outlet Pipes for the PGS System and Corrugated Perforated Polyethylene Tubing at Station 235+00.

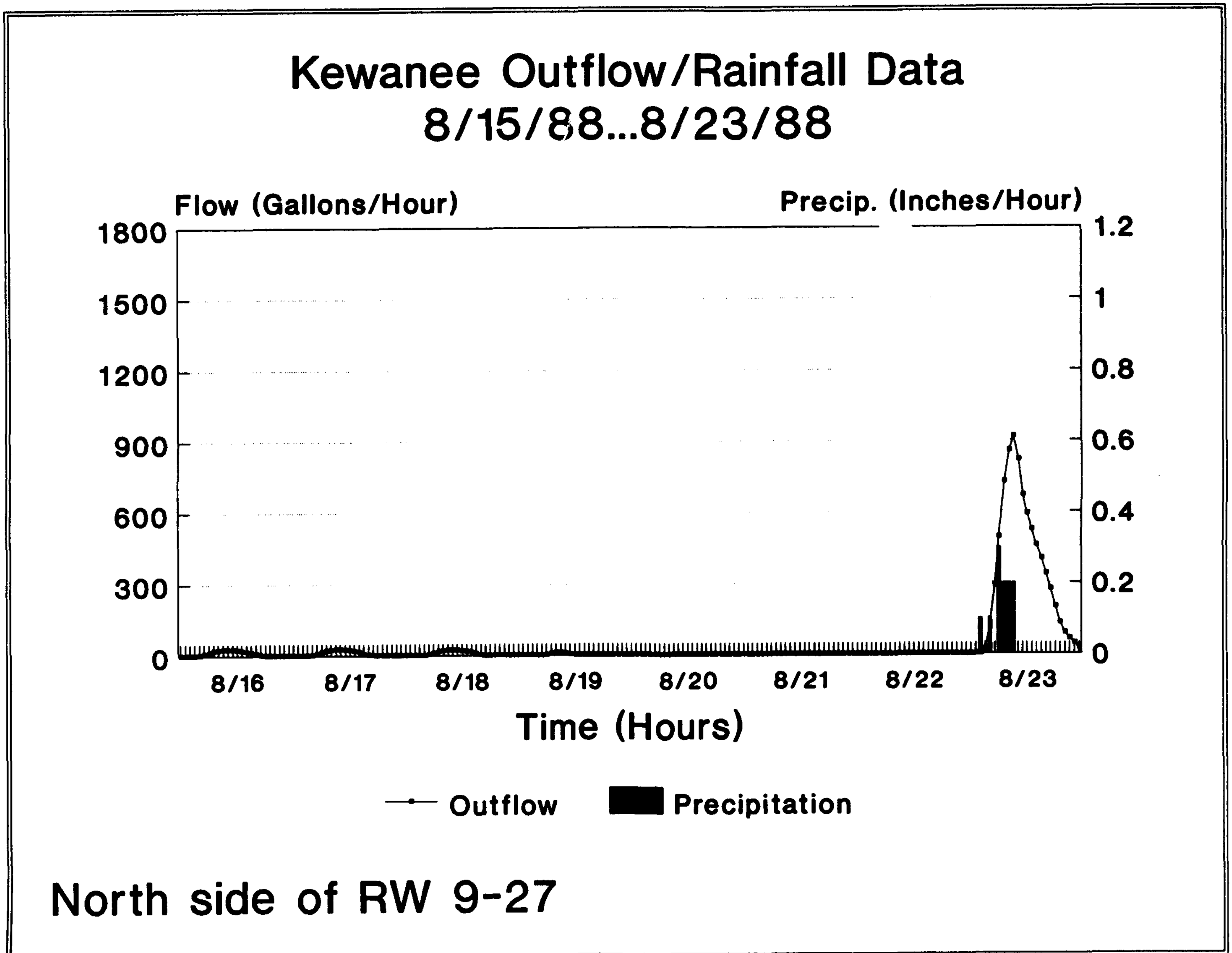

Figure 21. Outflow Results from PGS System as a Function of Precipitation for North Side of Runway 09-27.

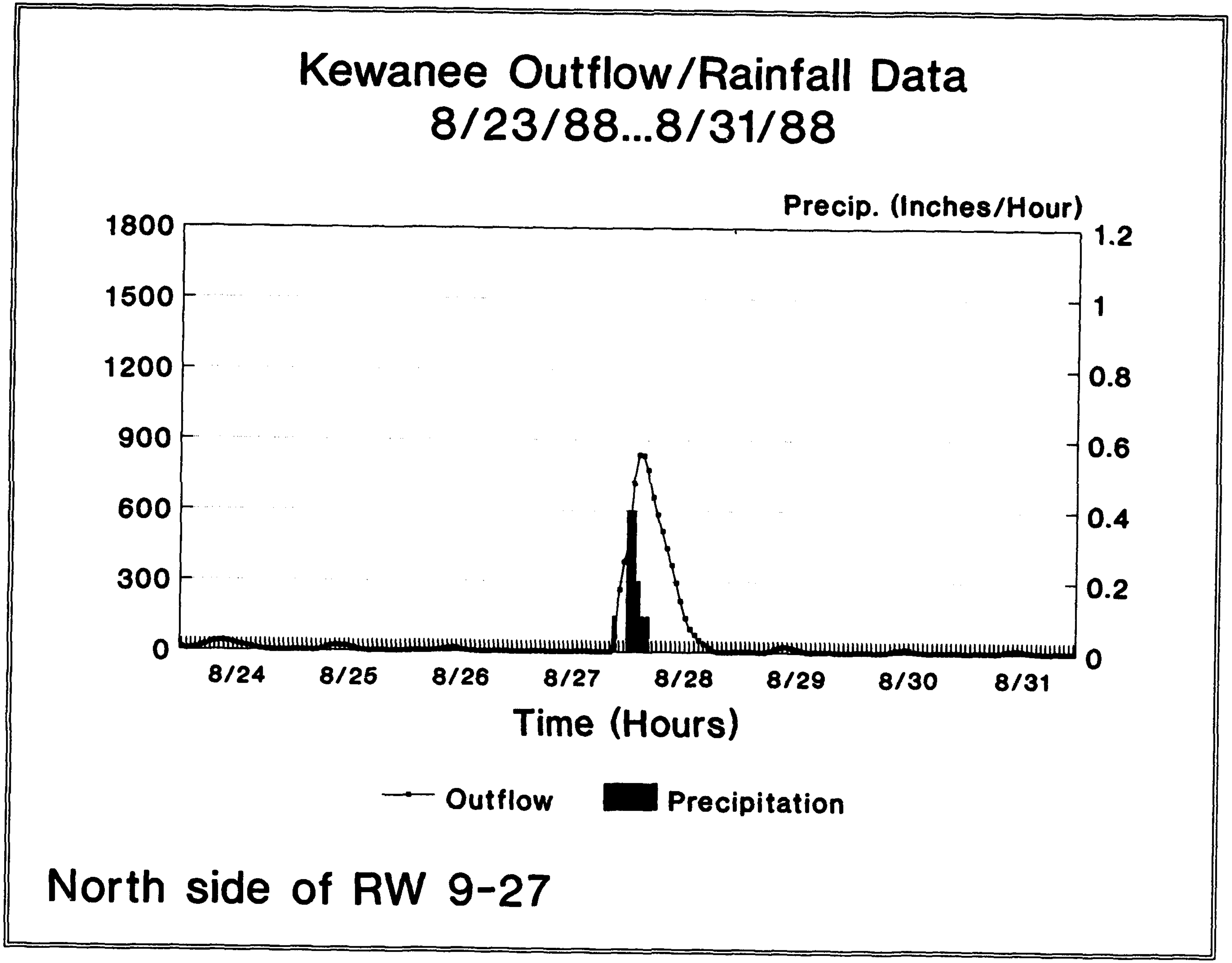

Figure 21. Continued

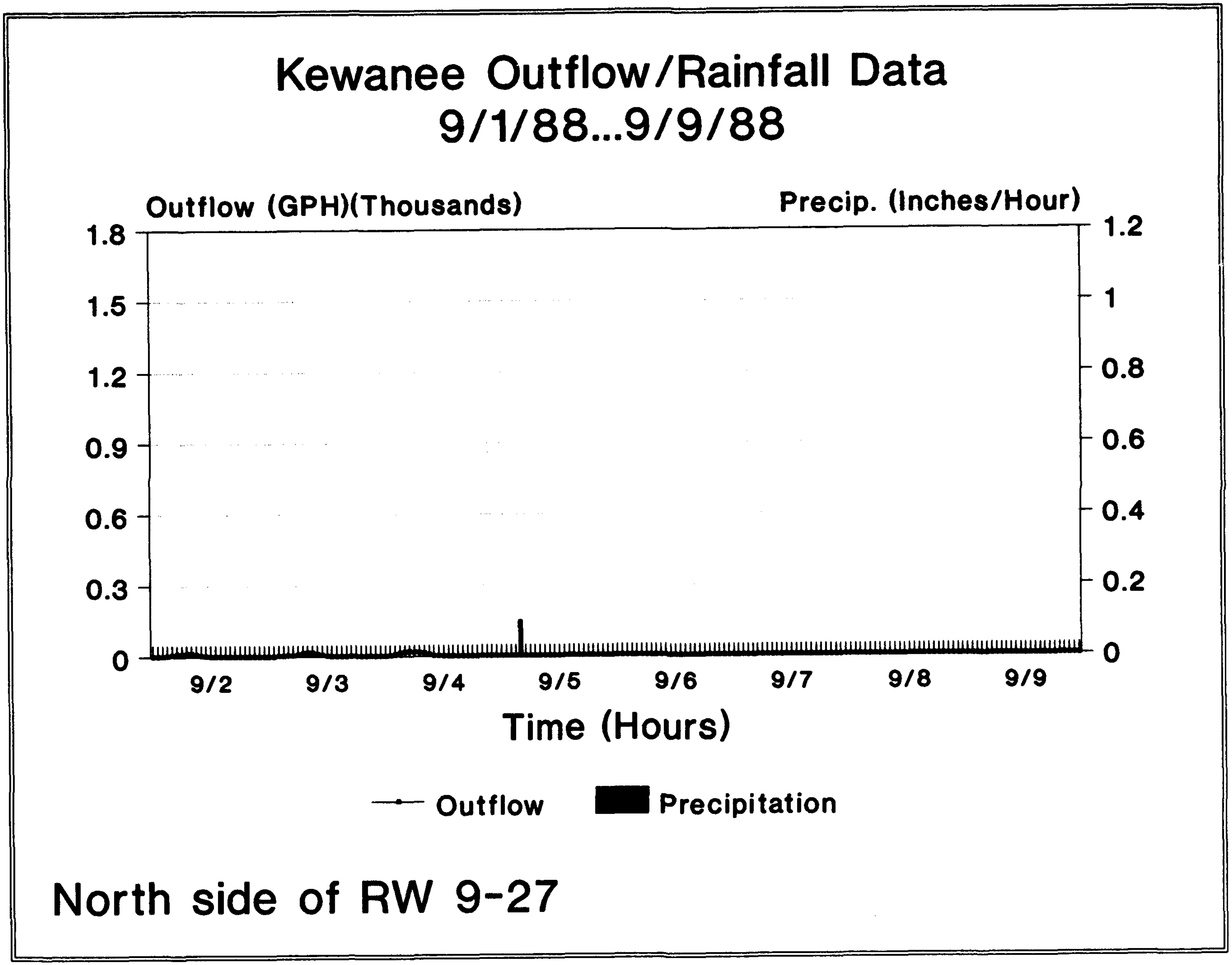

Figure 21. Continued.

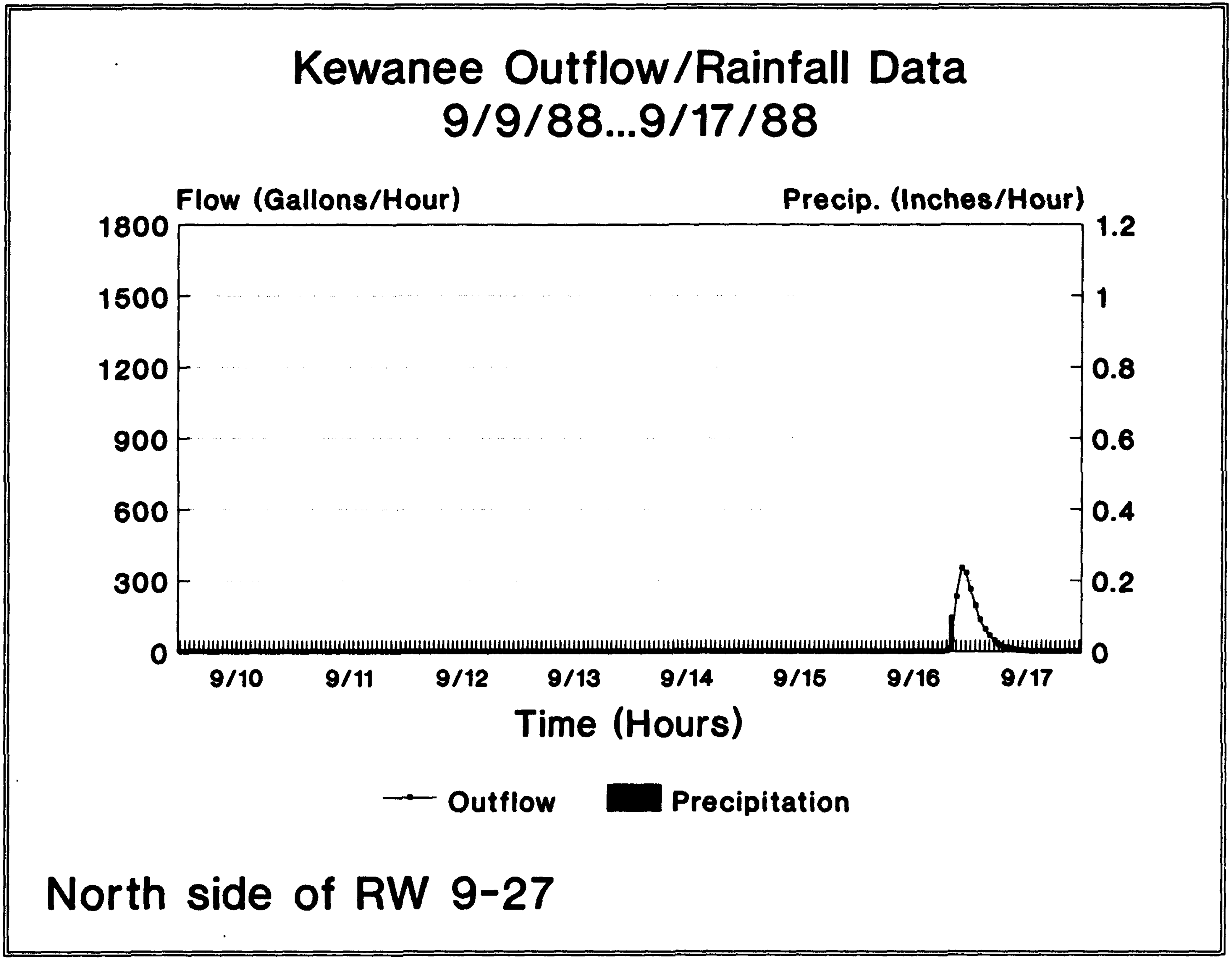

Figure 21. Continued

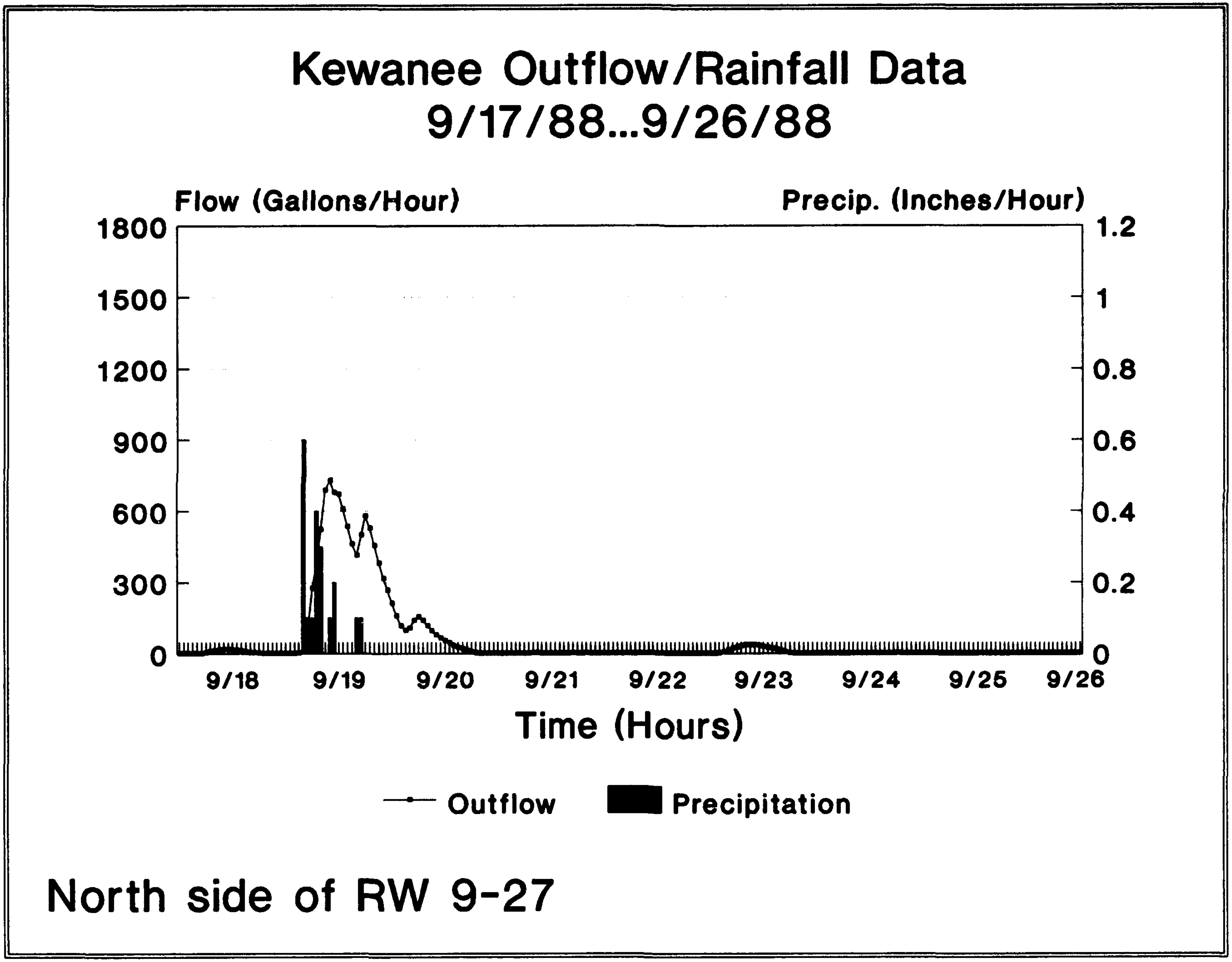

Figure 21. Continued

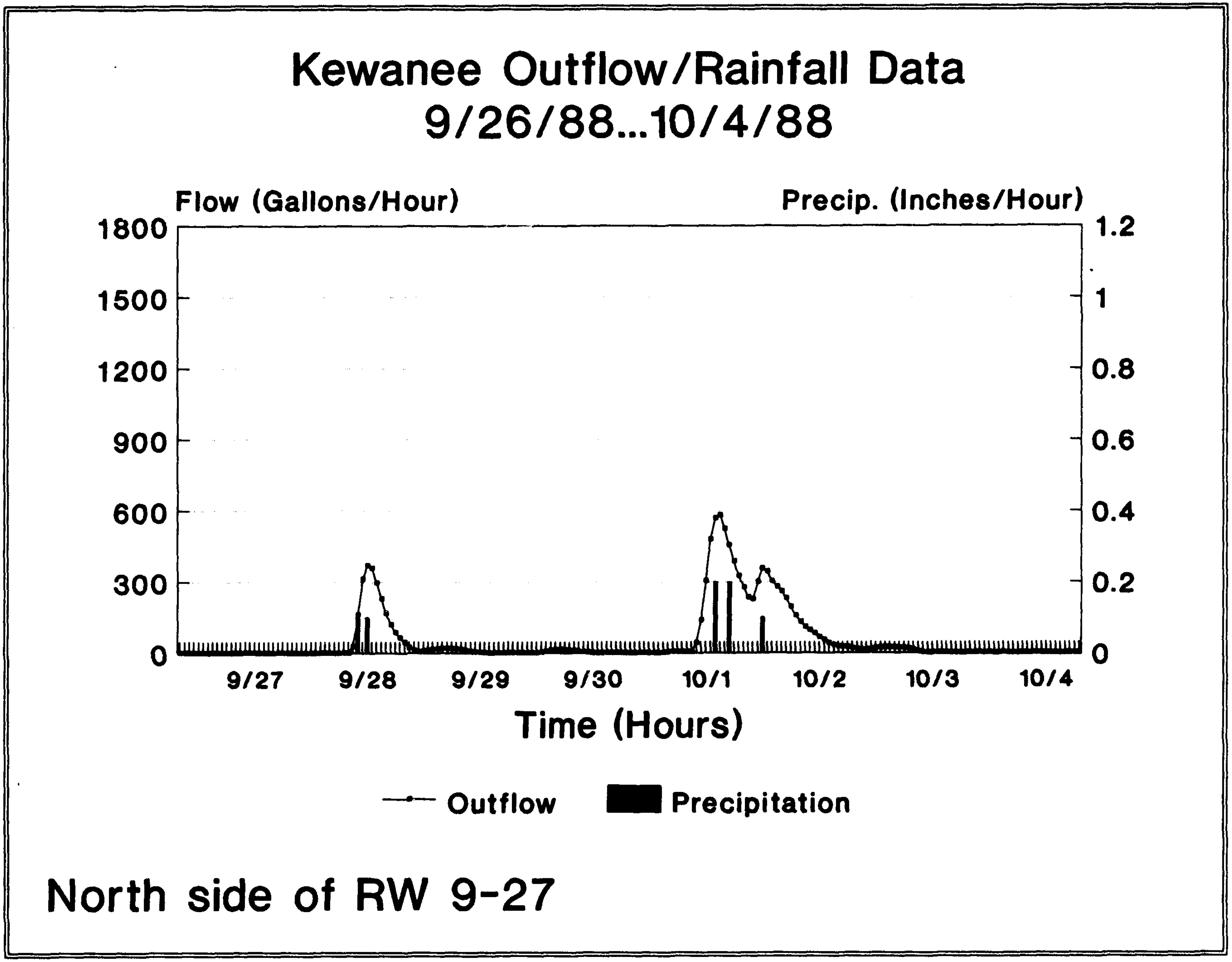

Figure 21. Continued

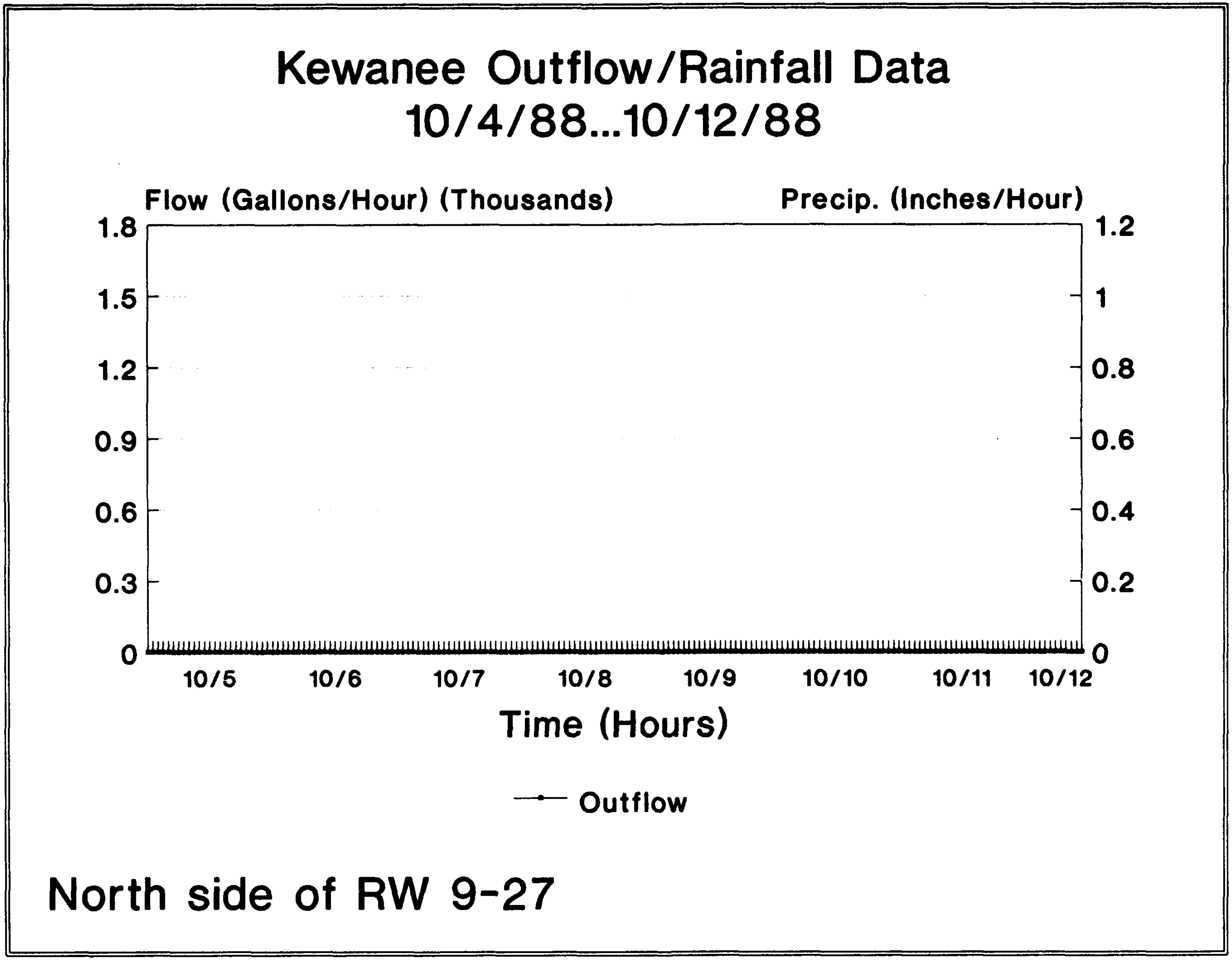

Figure 21. Continued

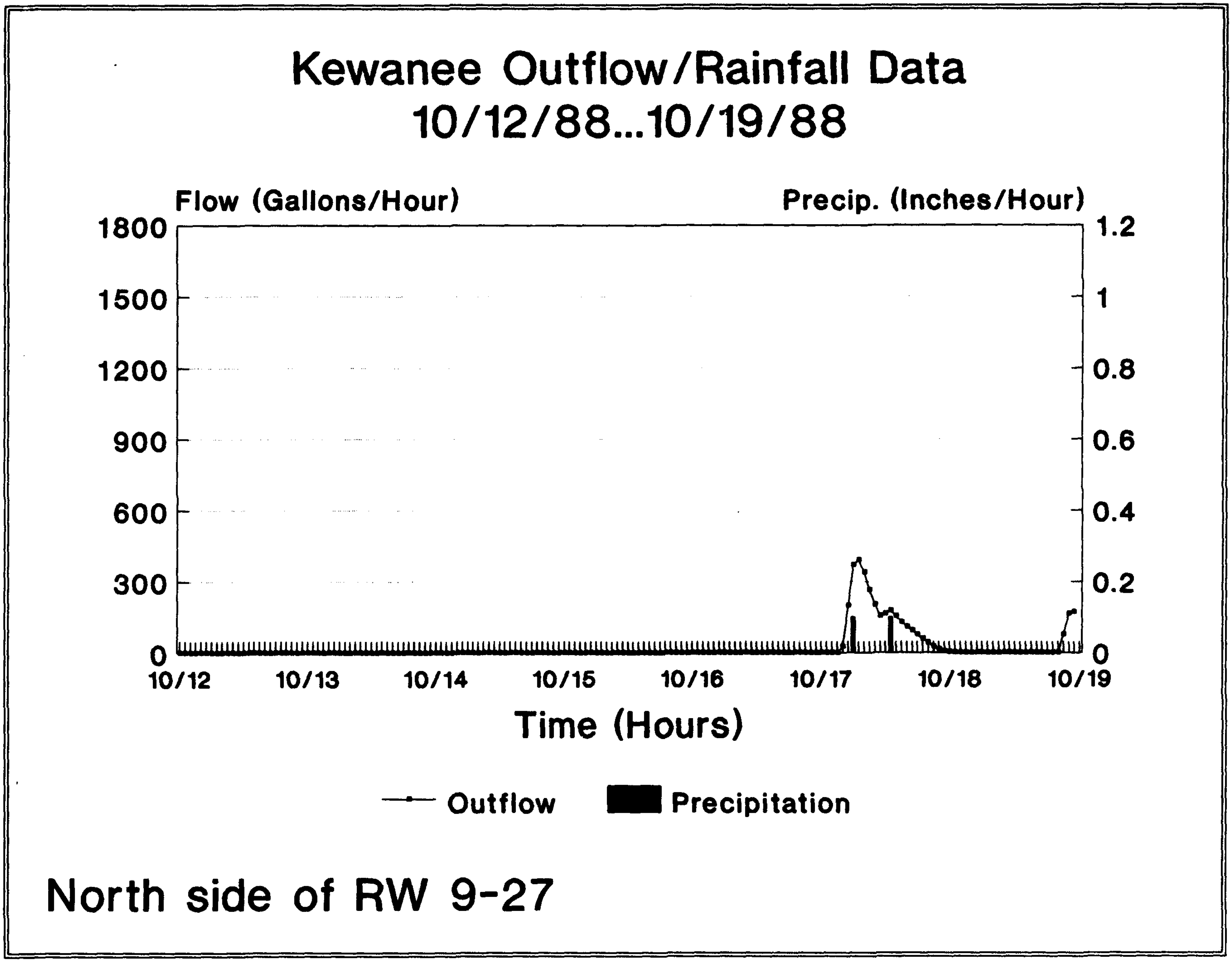

Figure 21. Continued

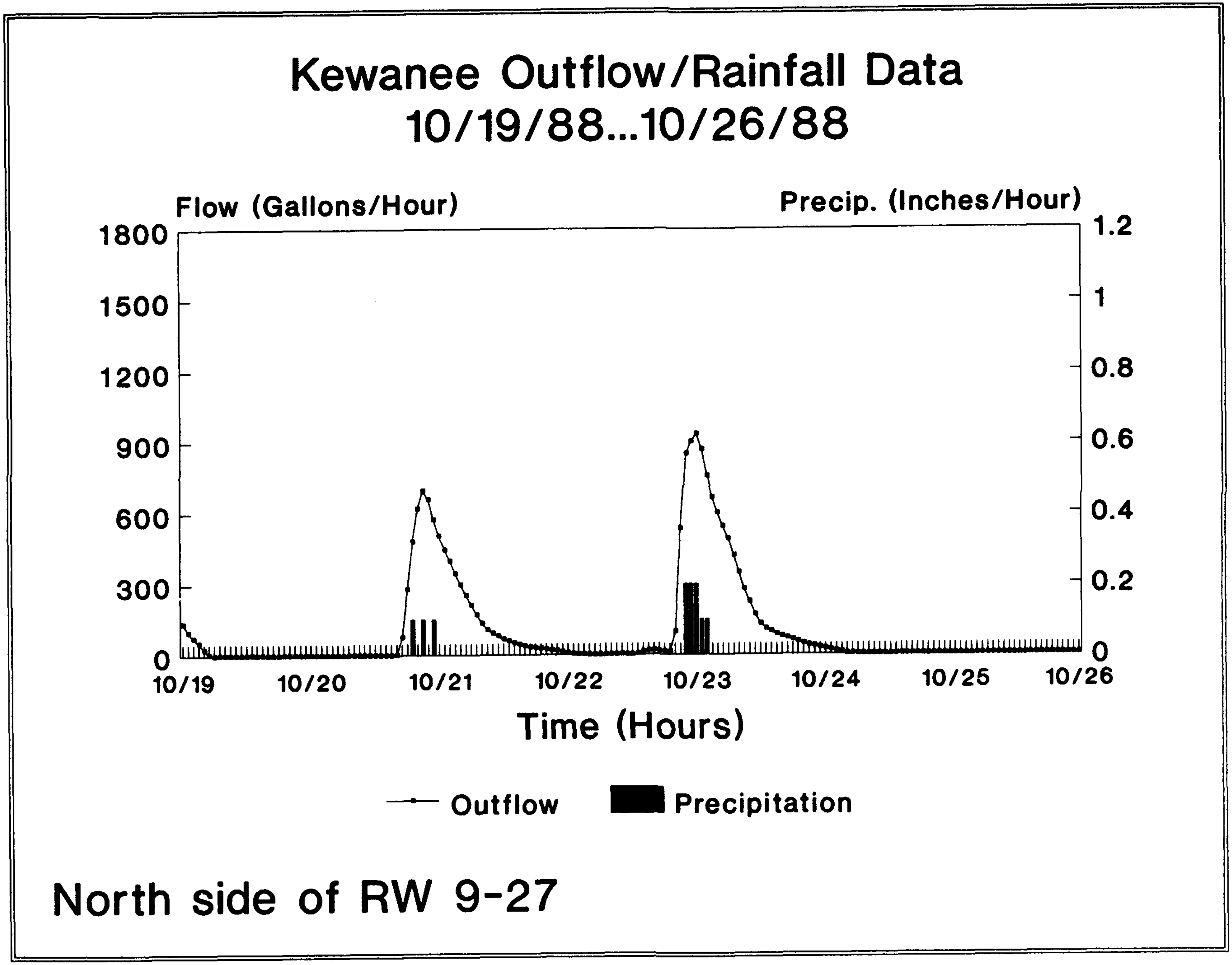

Figure 21. Continued

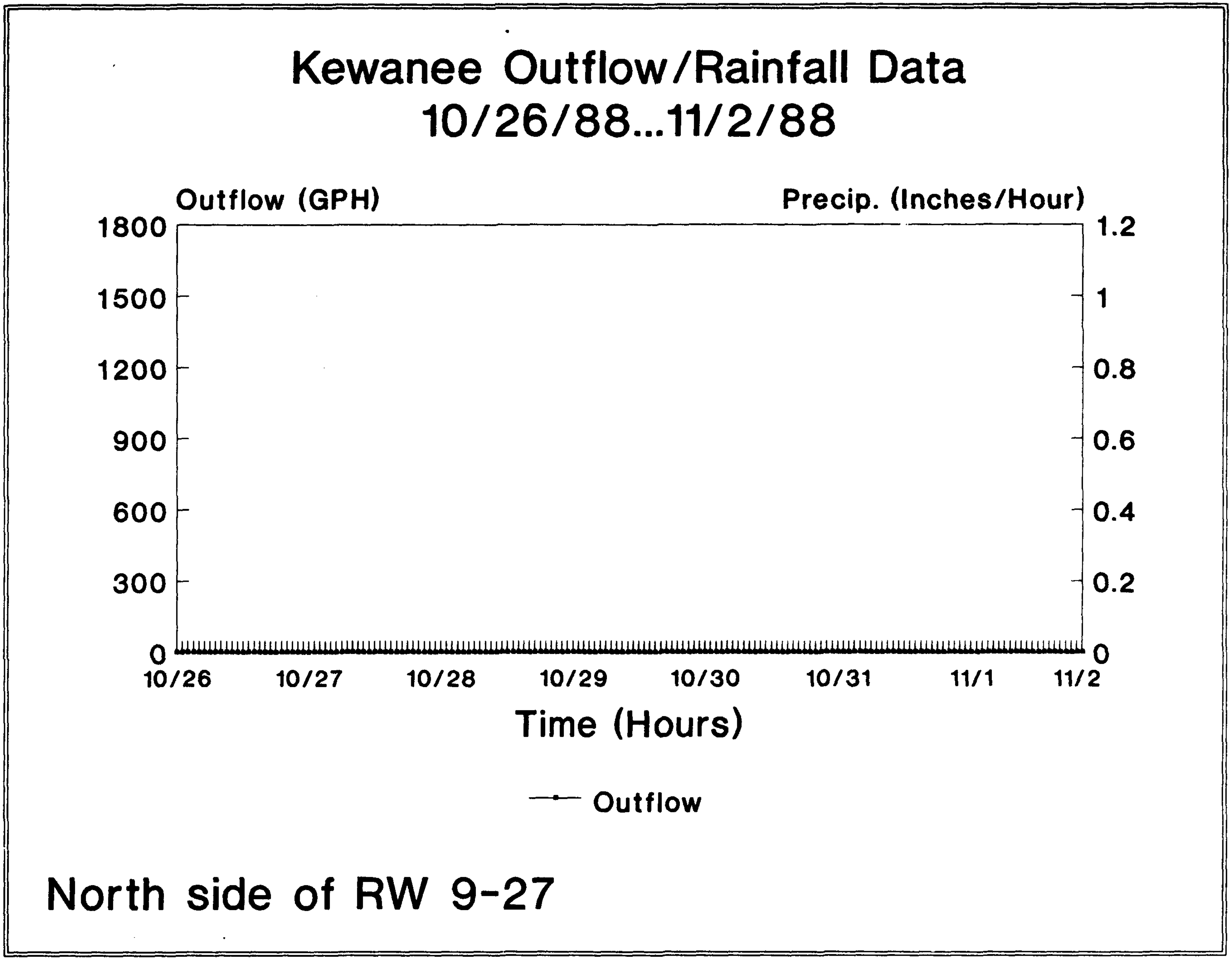

Figure 21. Continued

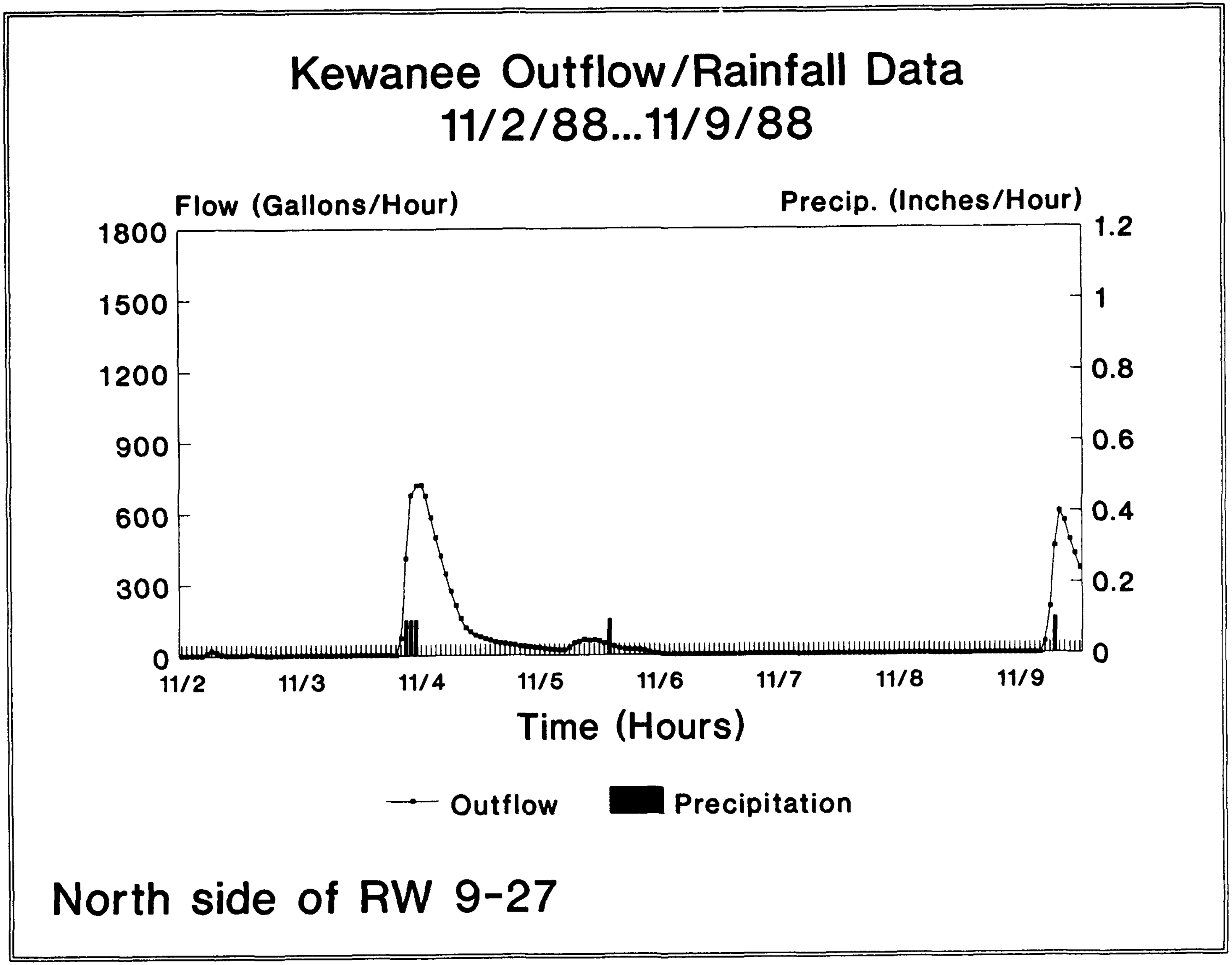

Figure 21. Continued

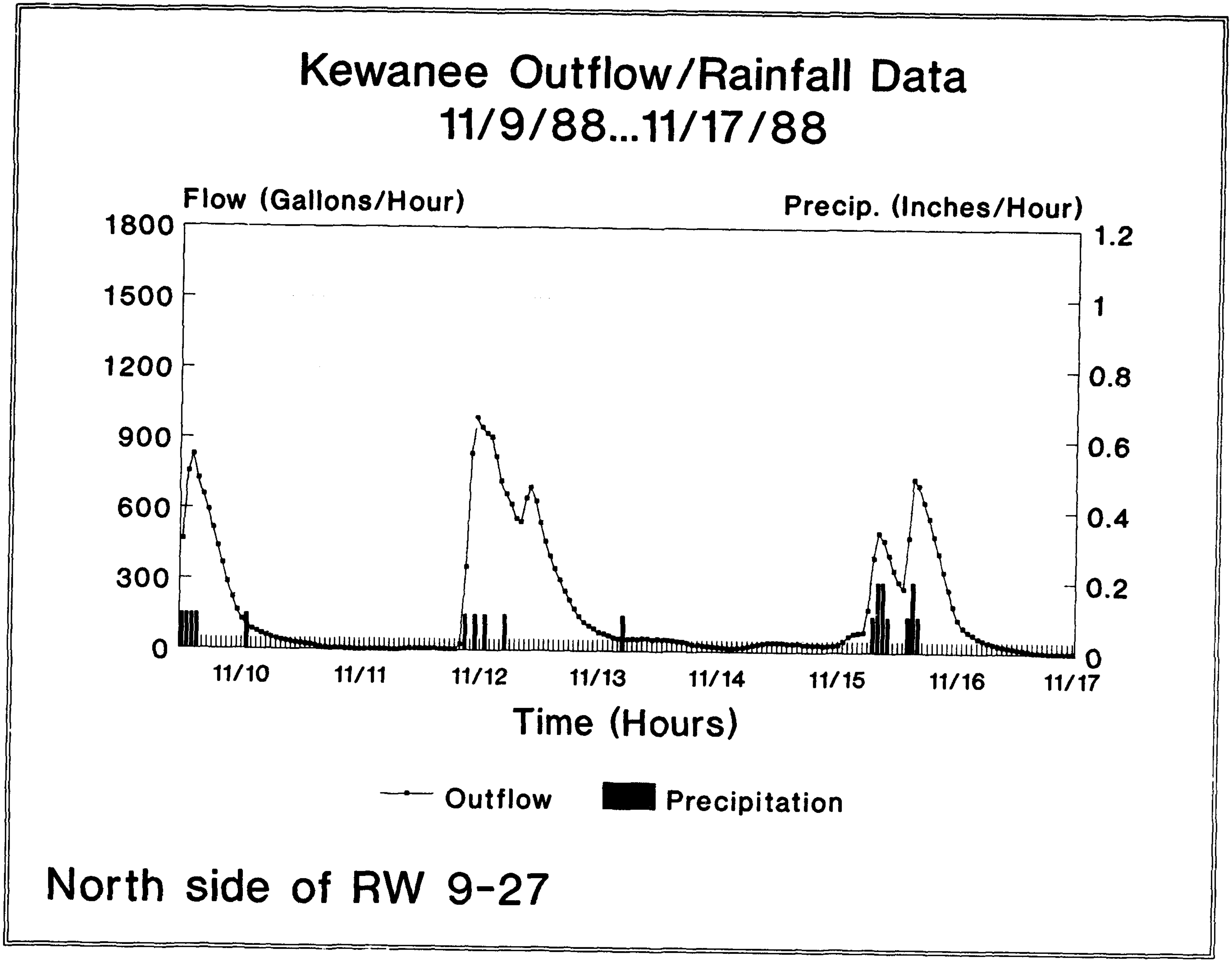

Figure 21. Continued

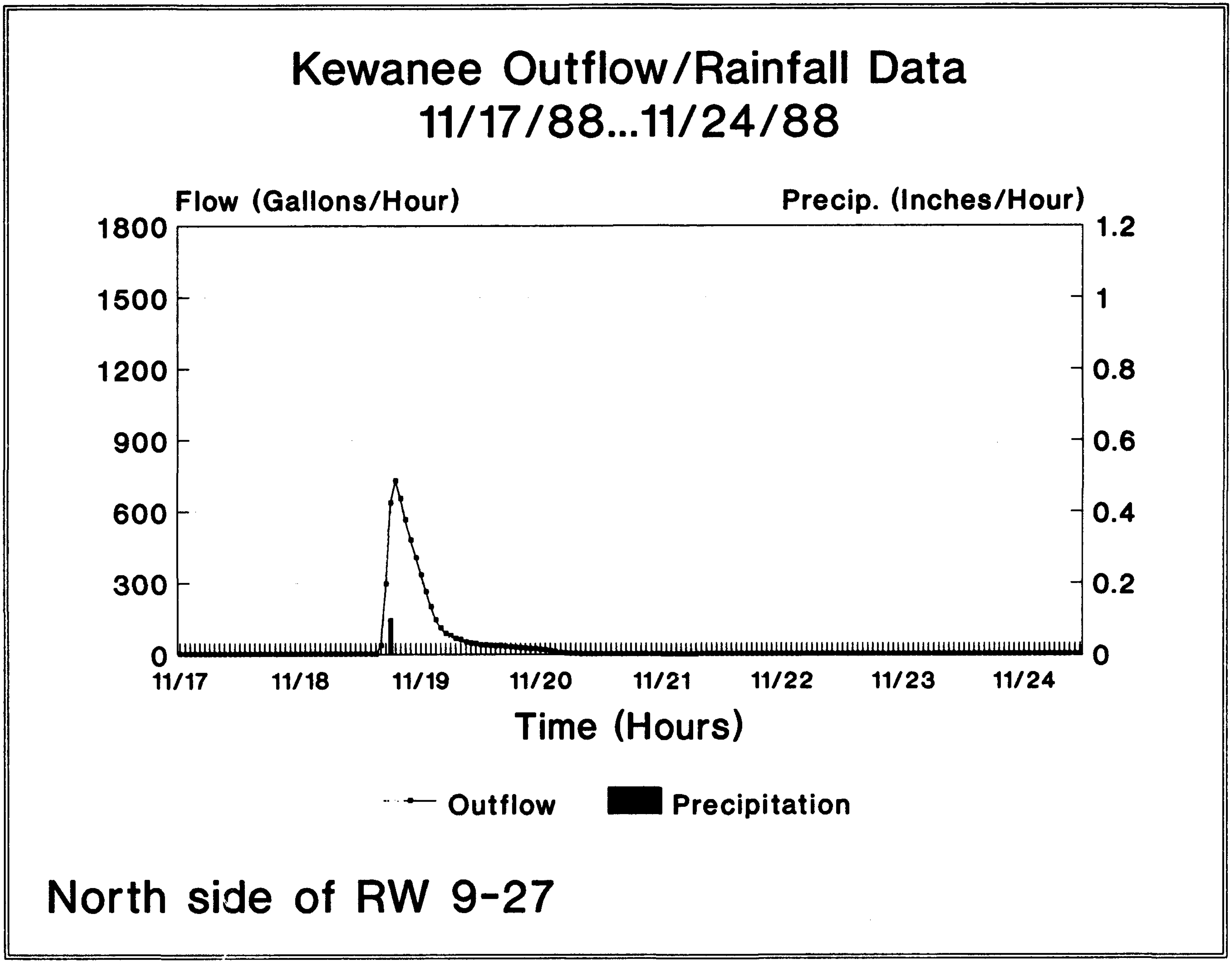

Figure 21. Continued

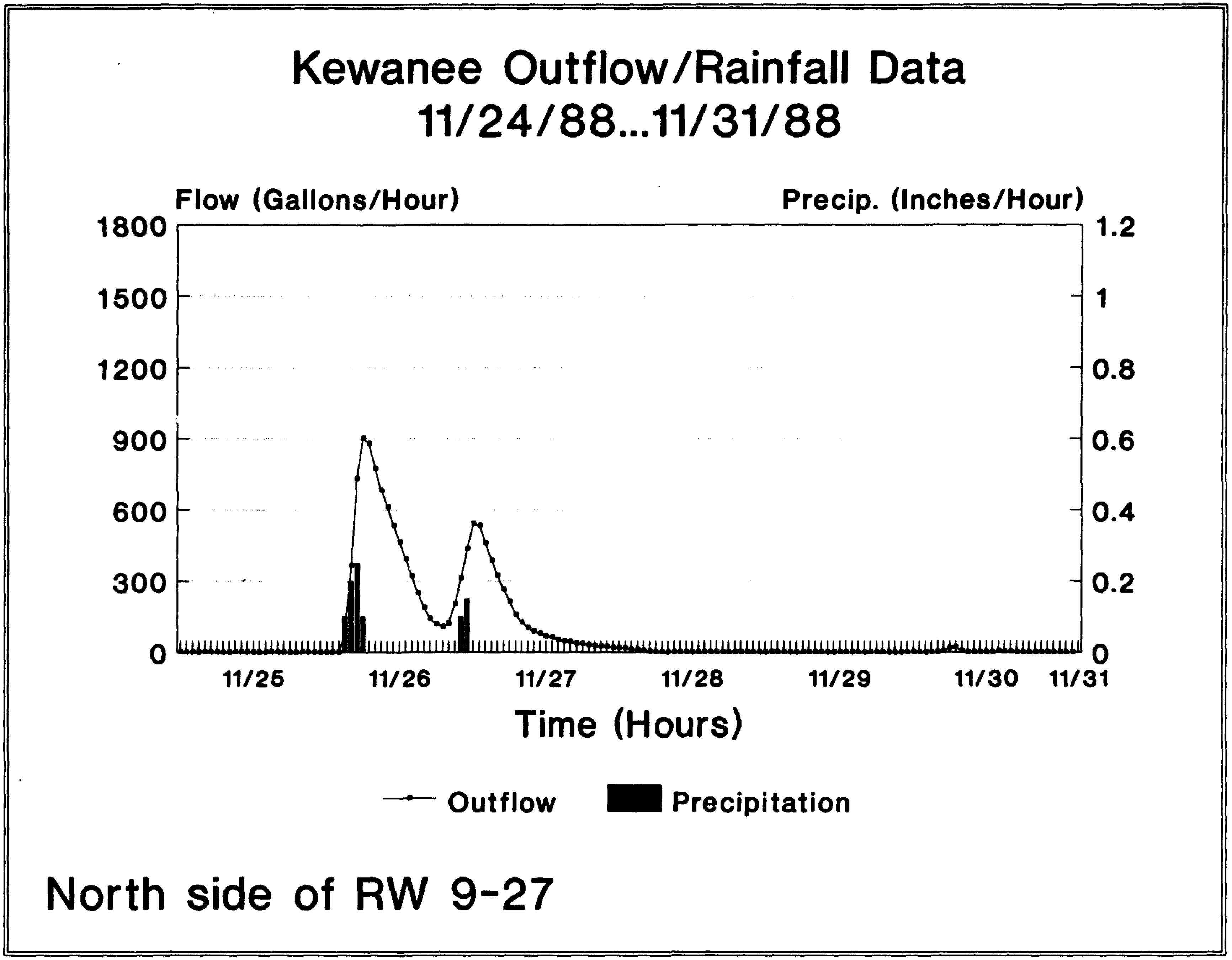

Figure 21. Continued

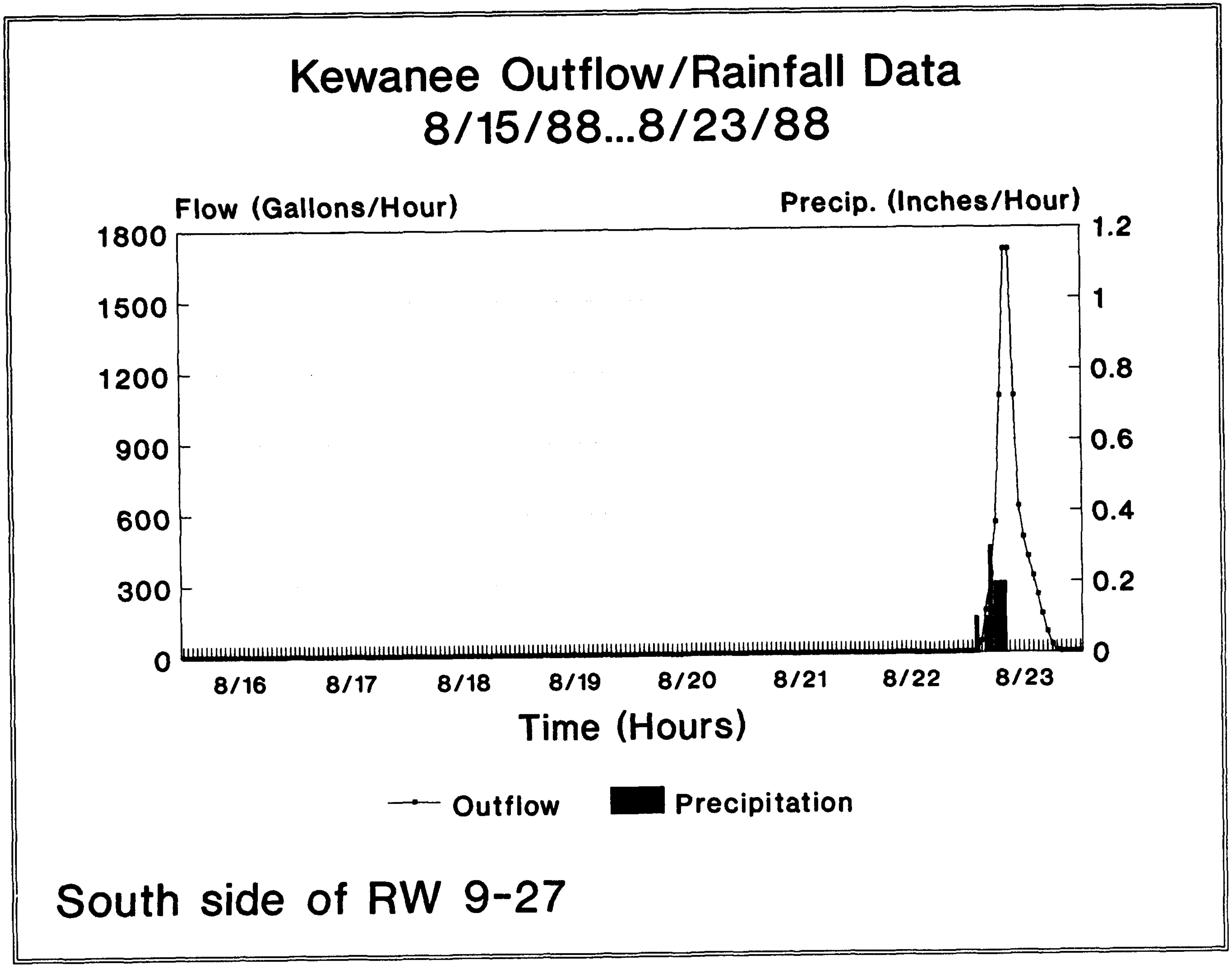

Figure 22. Outflow Results from PGS System as a Function of Precipitation for the South Side of Runway 09-27.

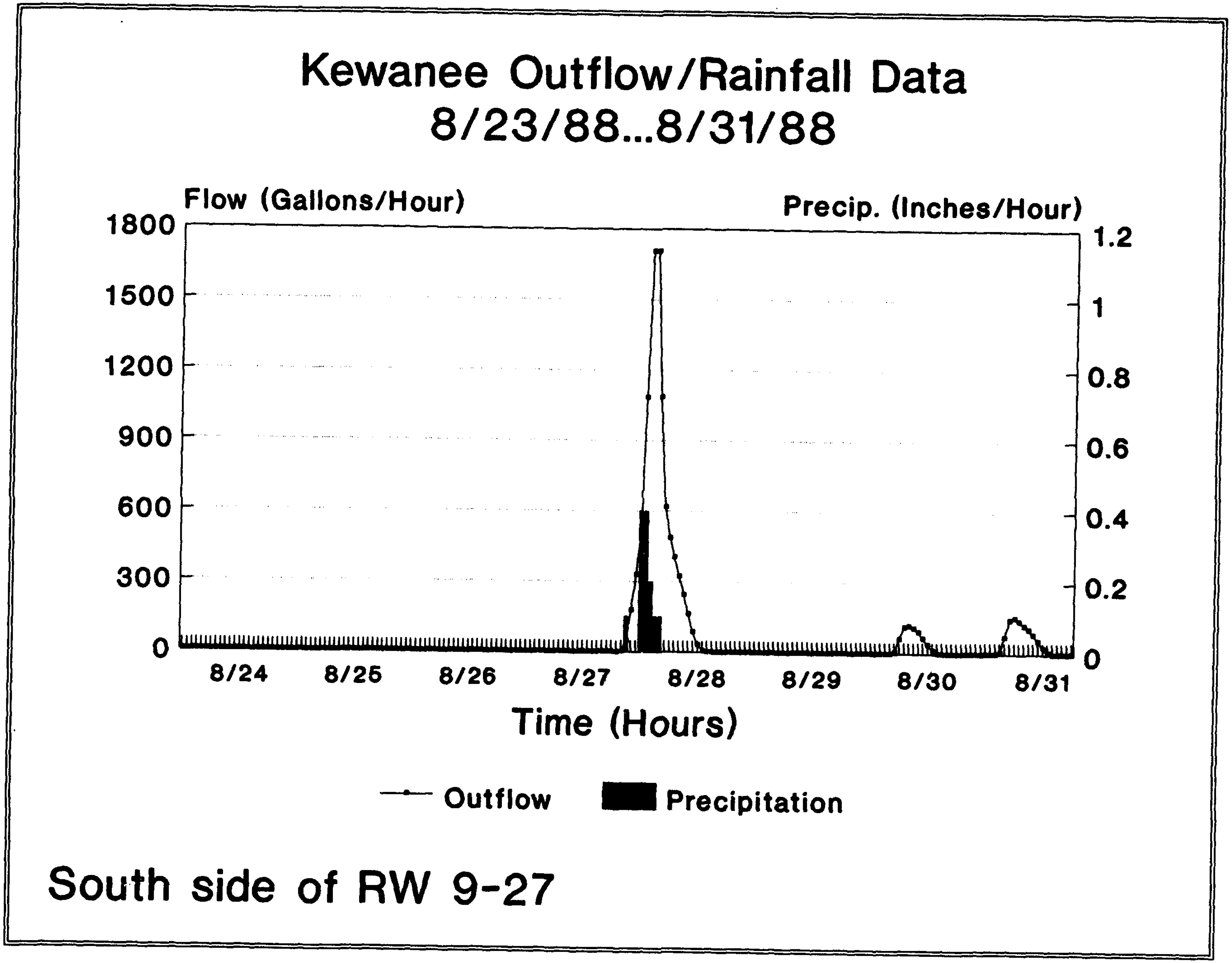

Figure 22. Continued

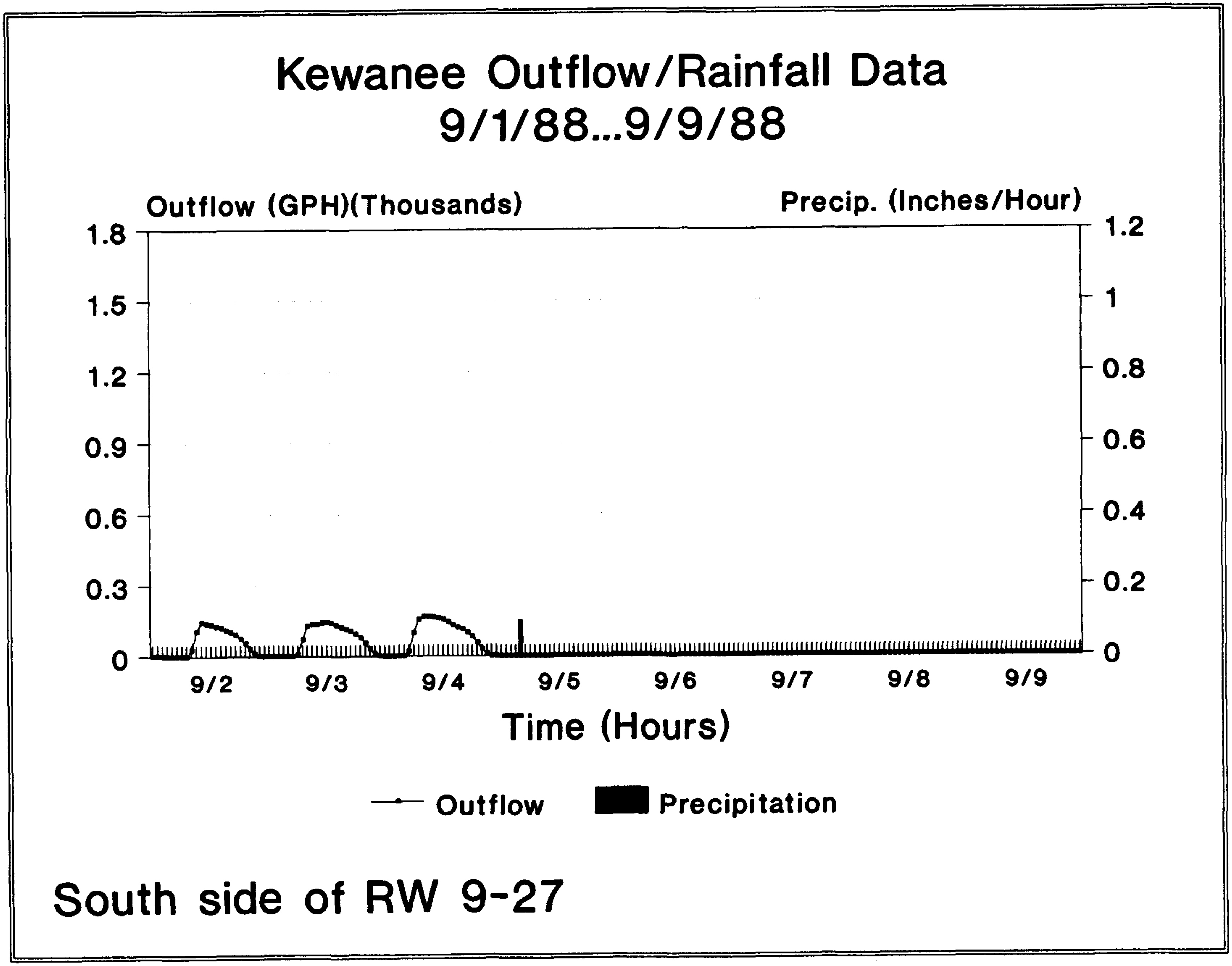

Figure 22. Continued

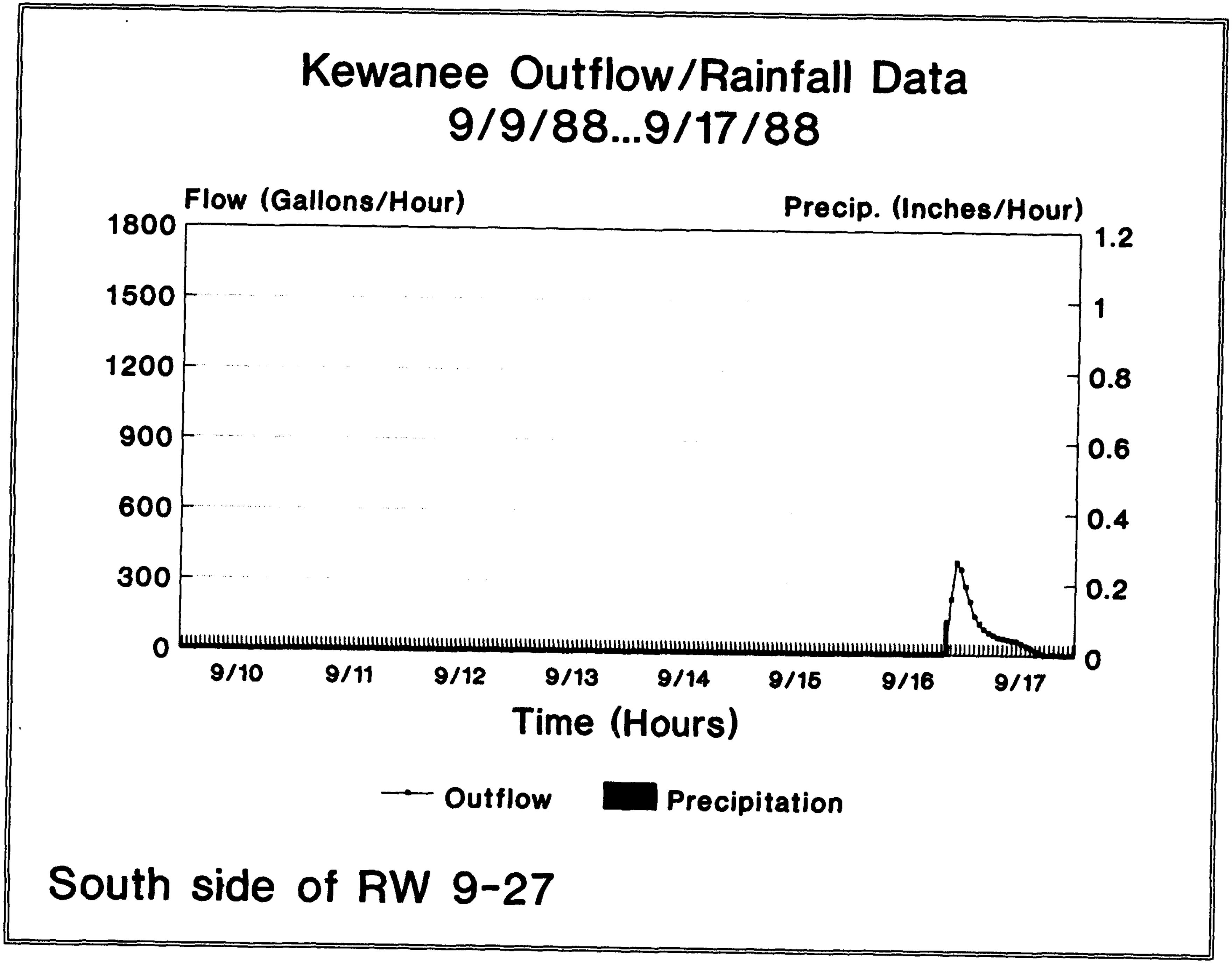

Figure 22. Continued

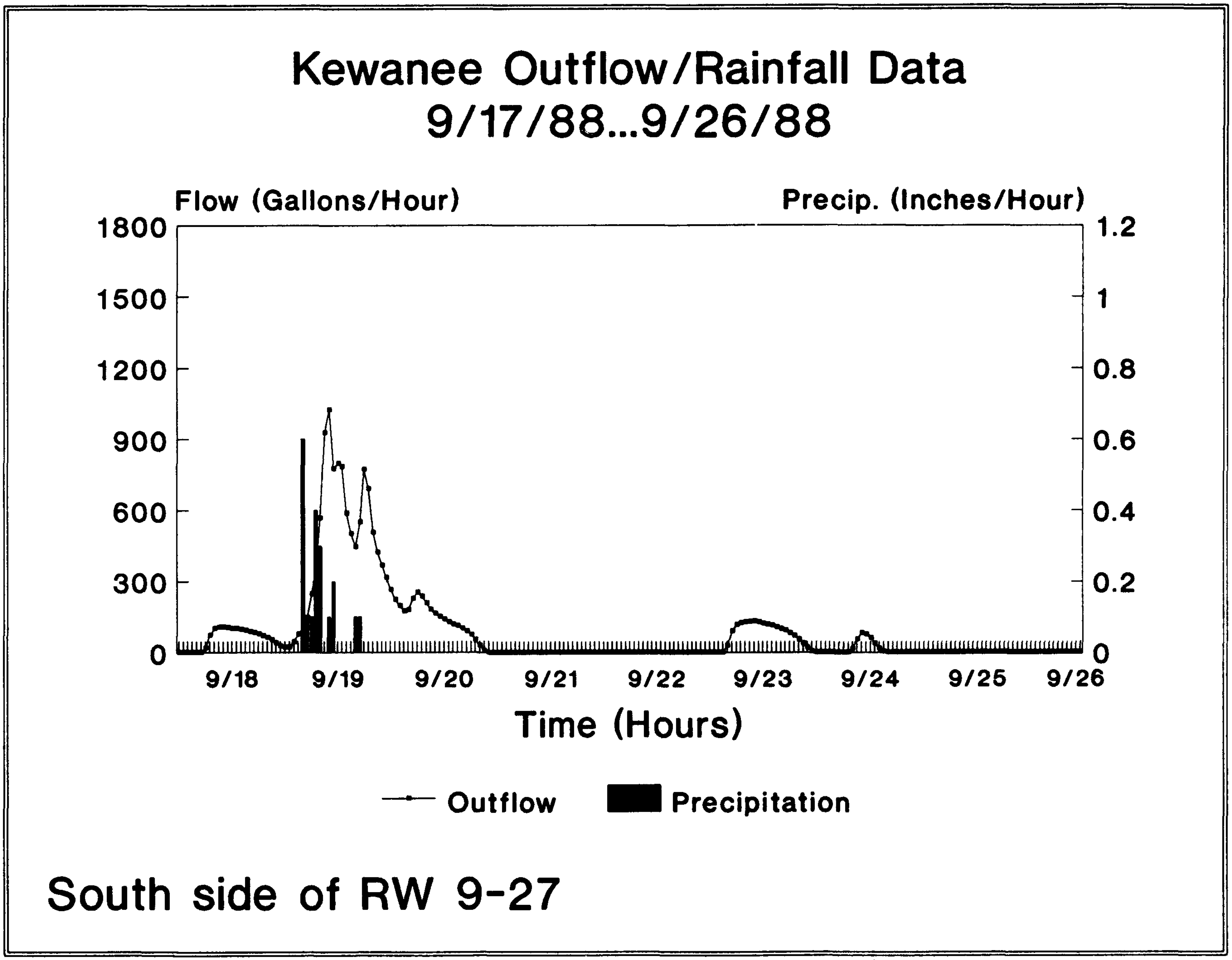

Figure 22. Continued

53

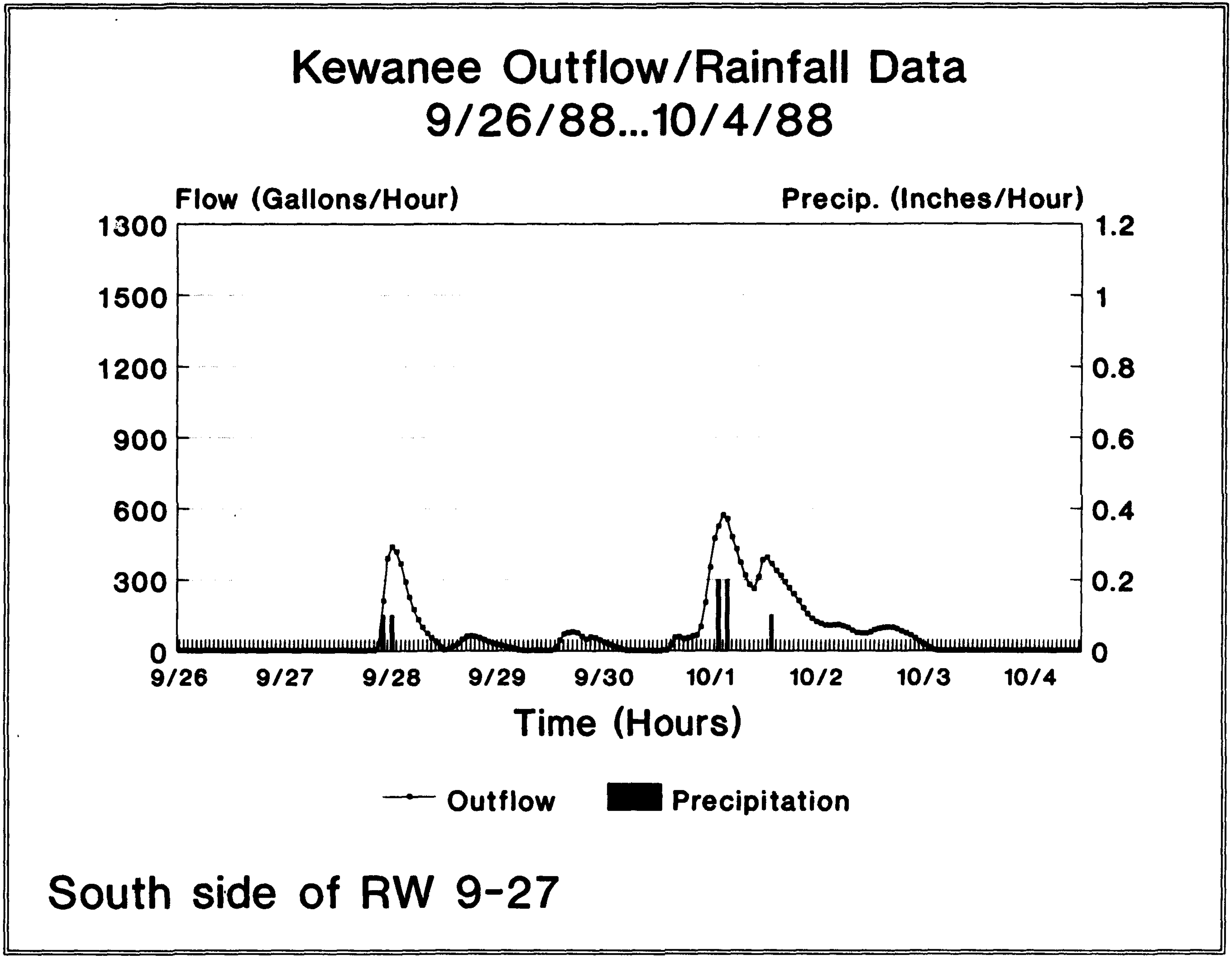

Figure 22. Continued

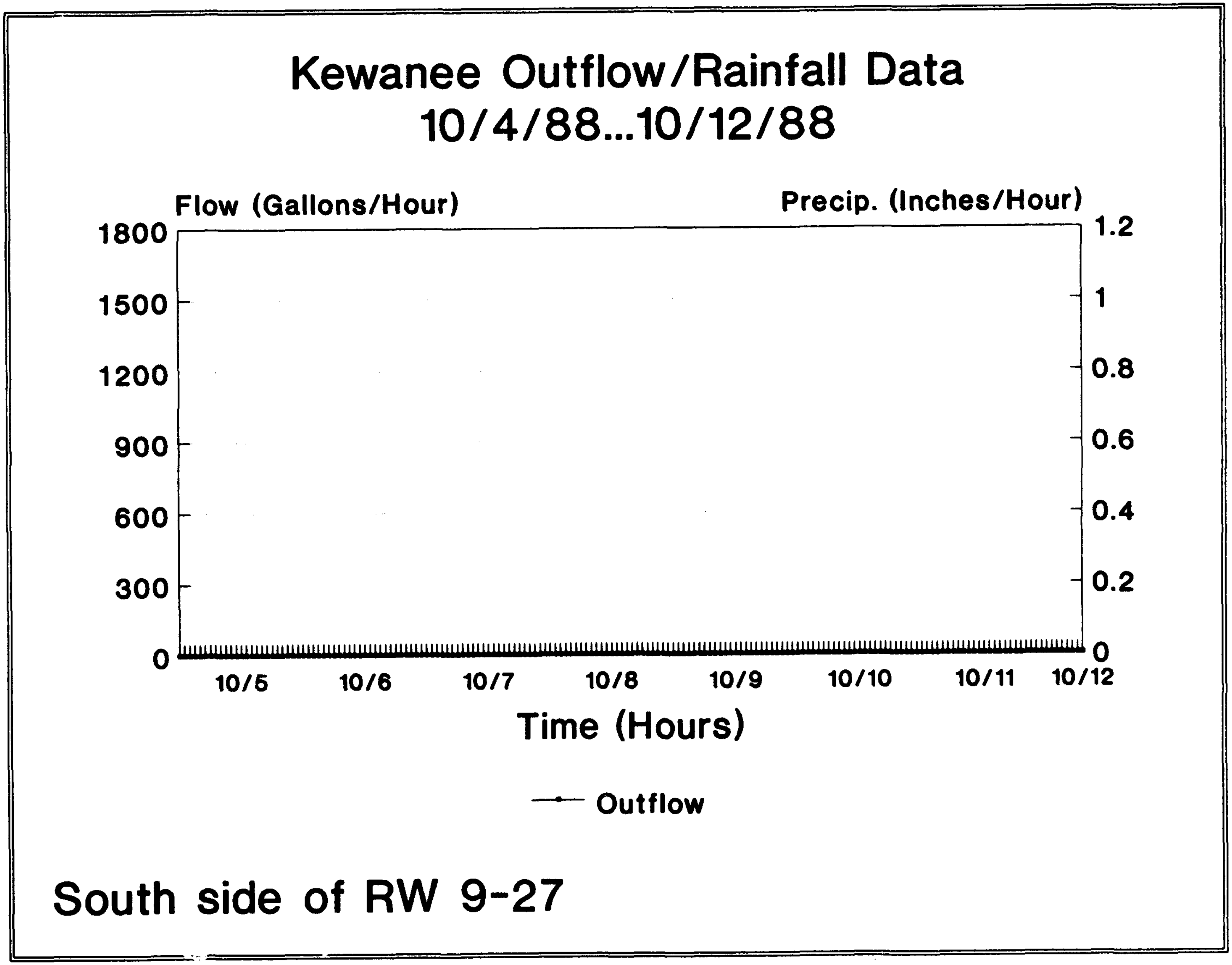

Figure 22. Continued

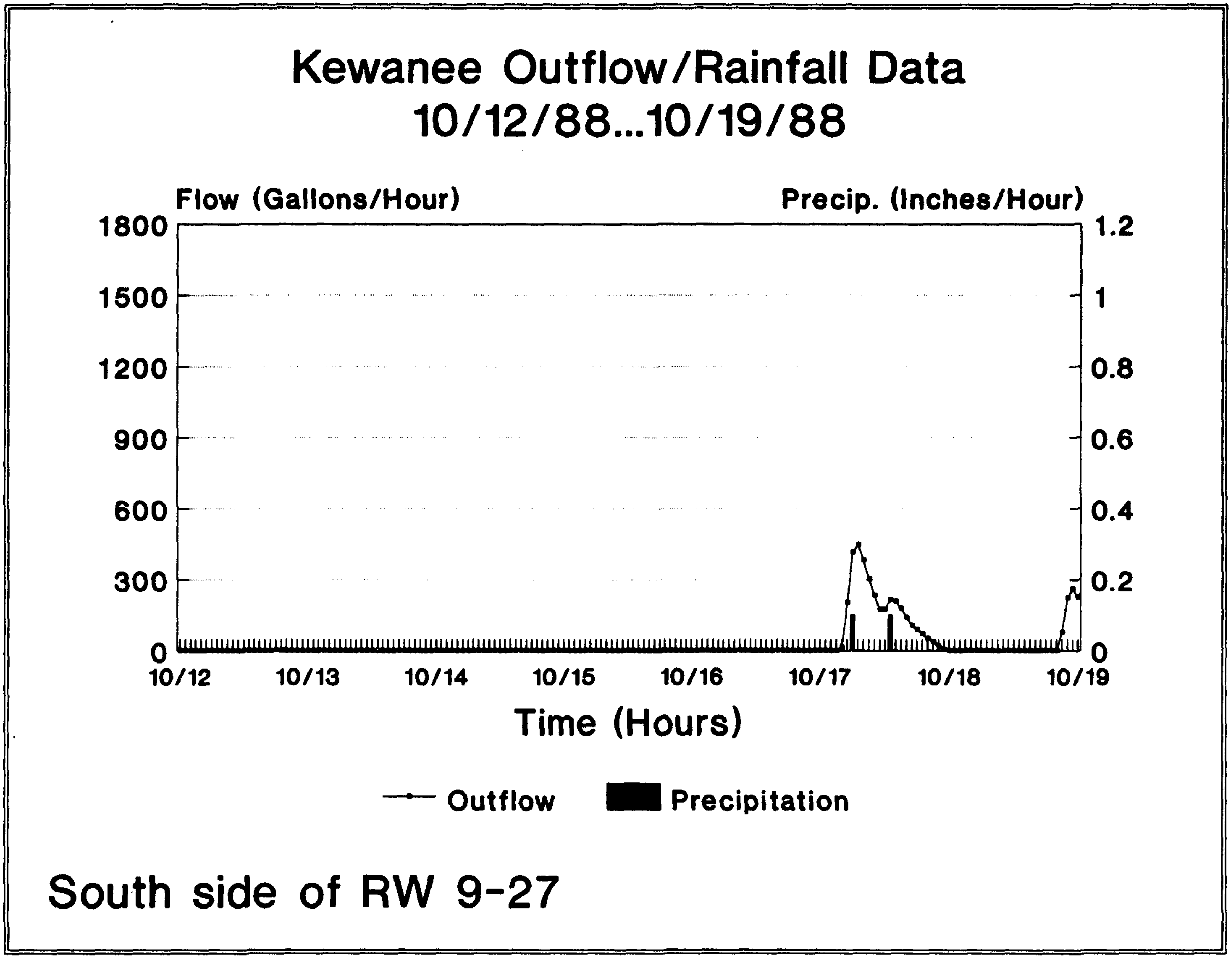

Figure 22. Continued

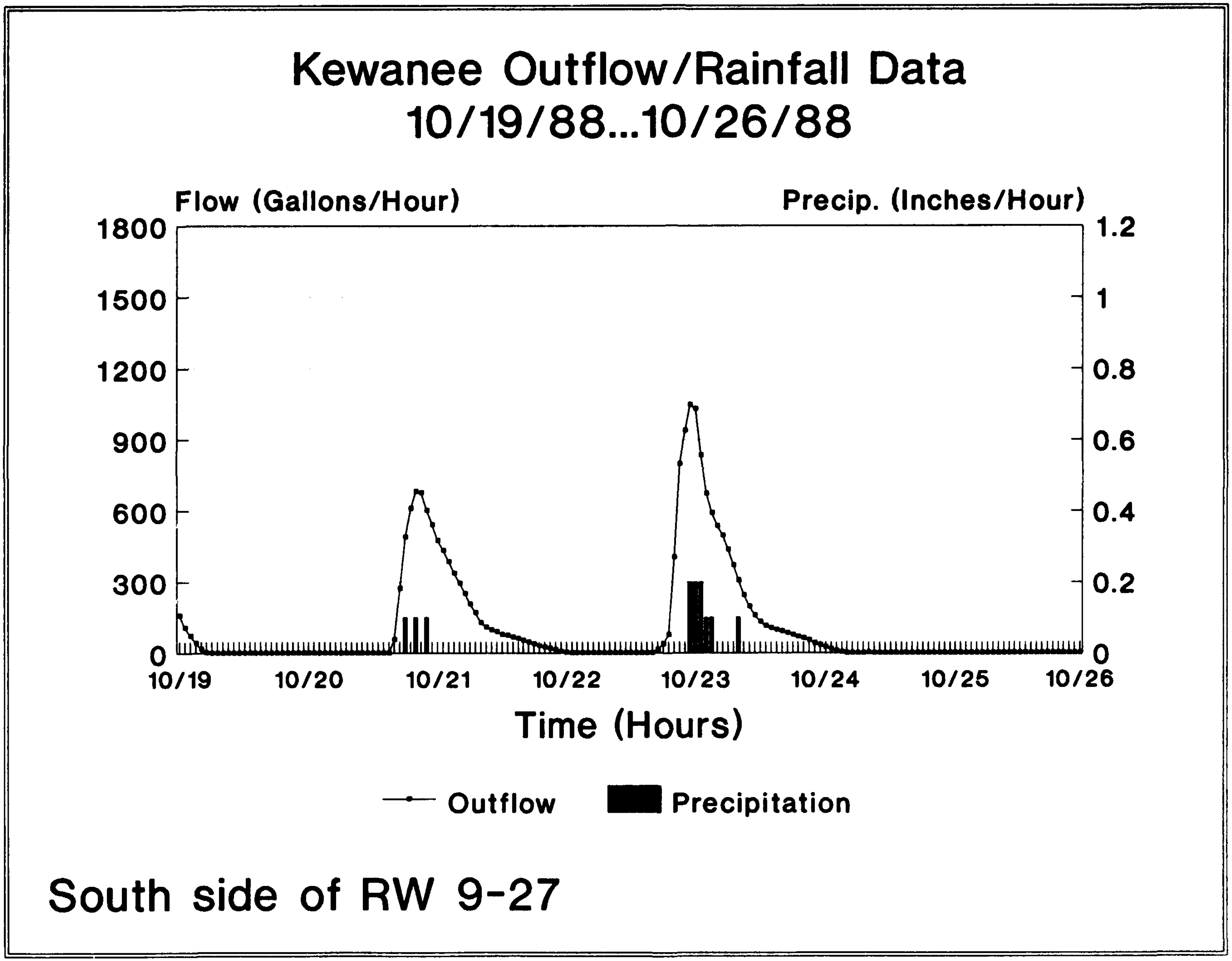

Figure 22. Continued

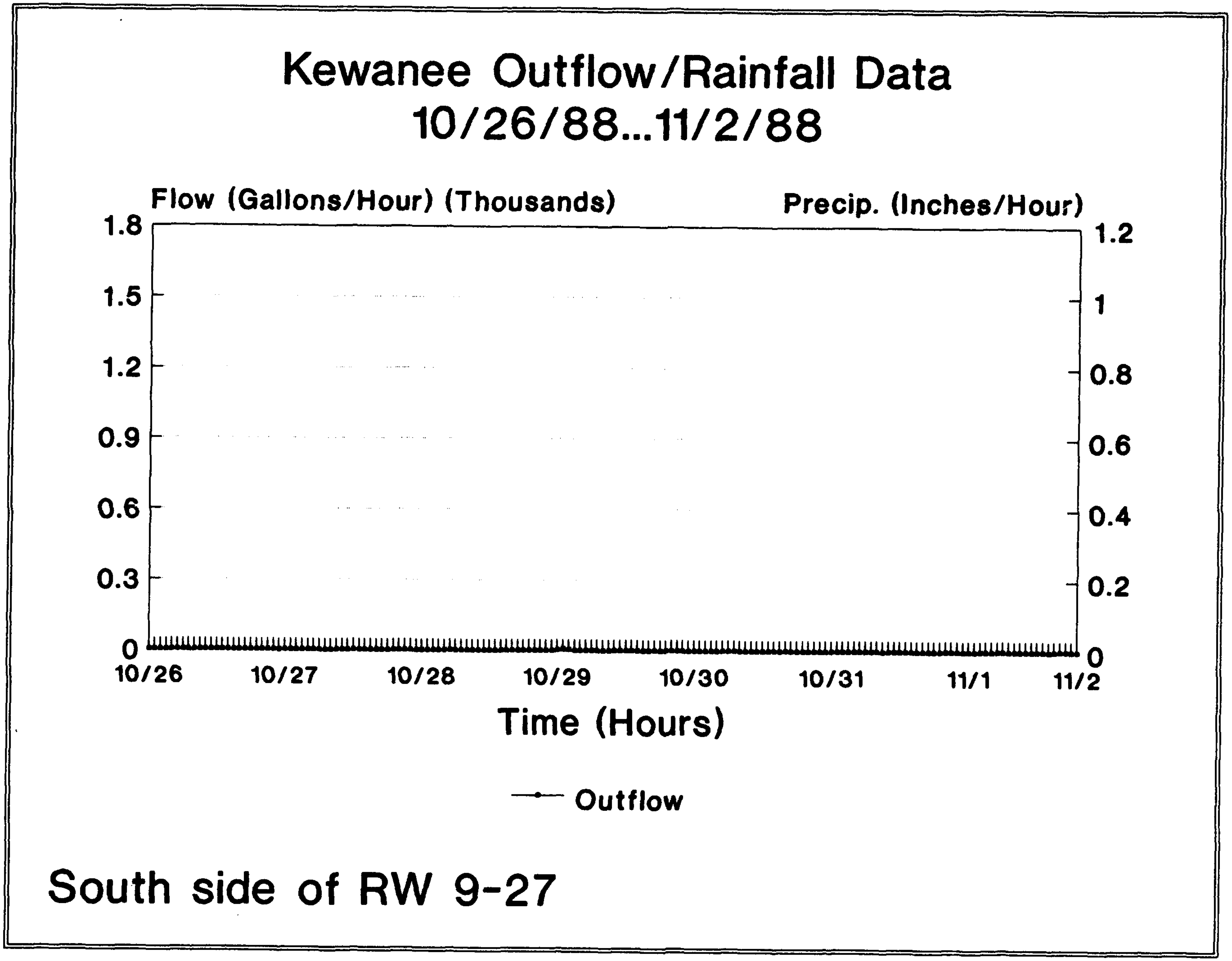

Figure 22. Continued

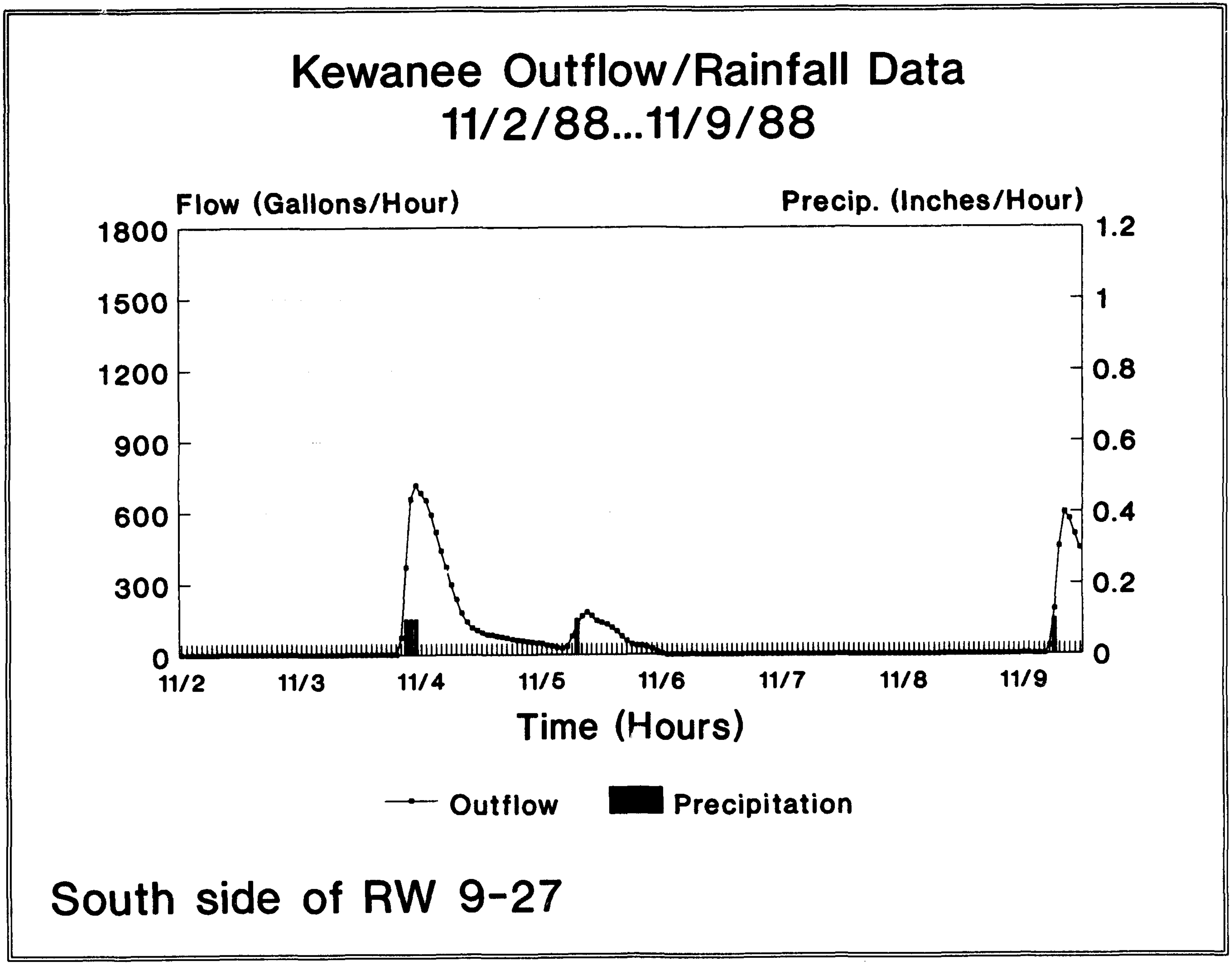

Figure 22. Continued

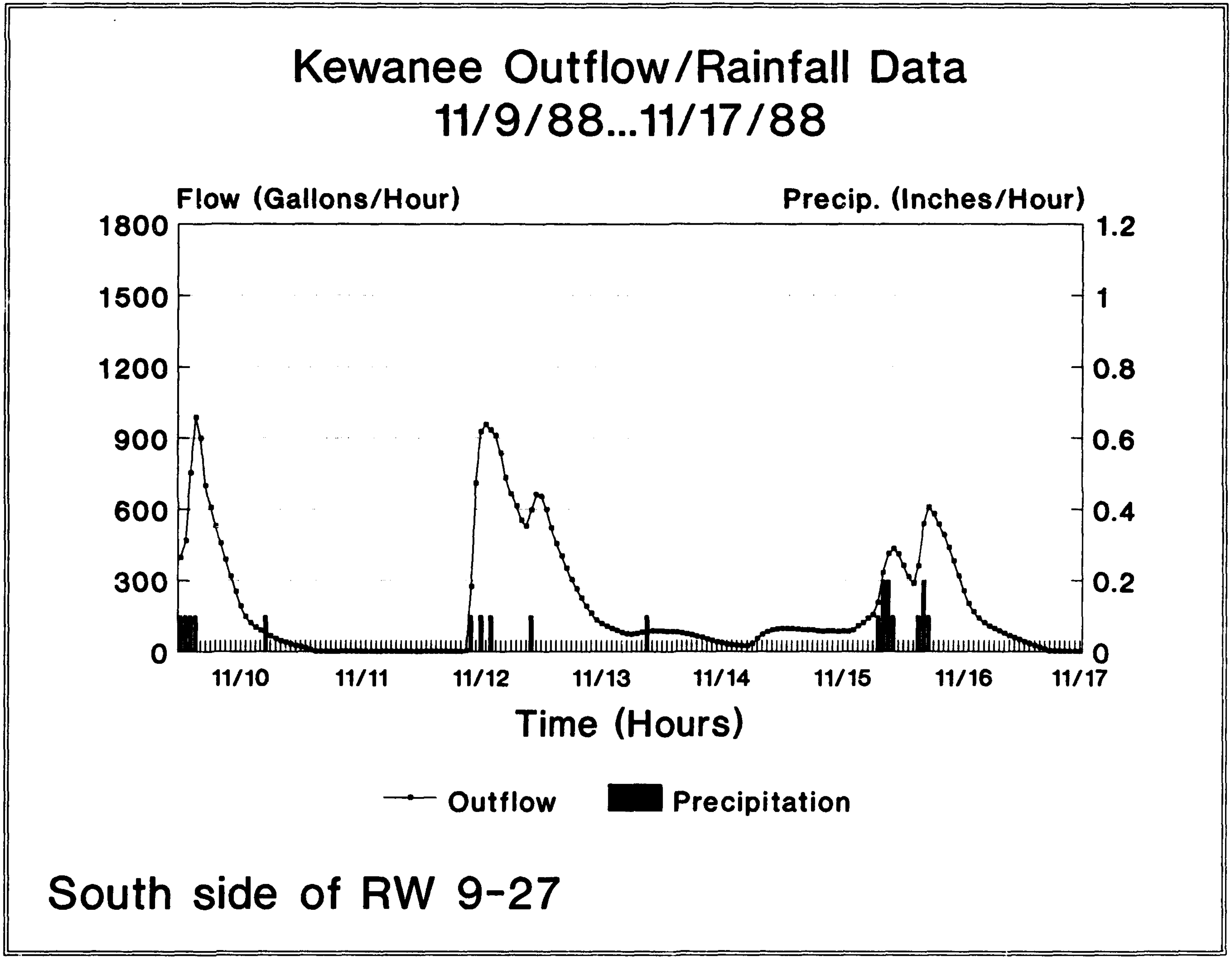

Figure 22. Continued

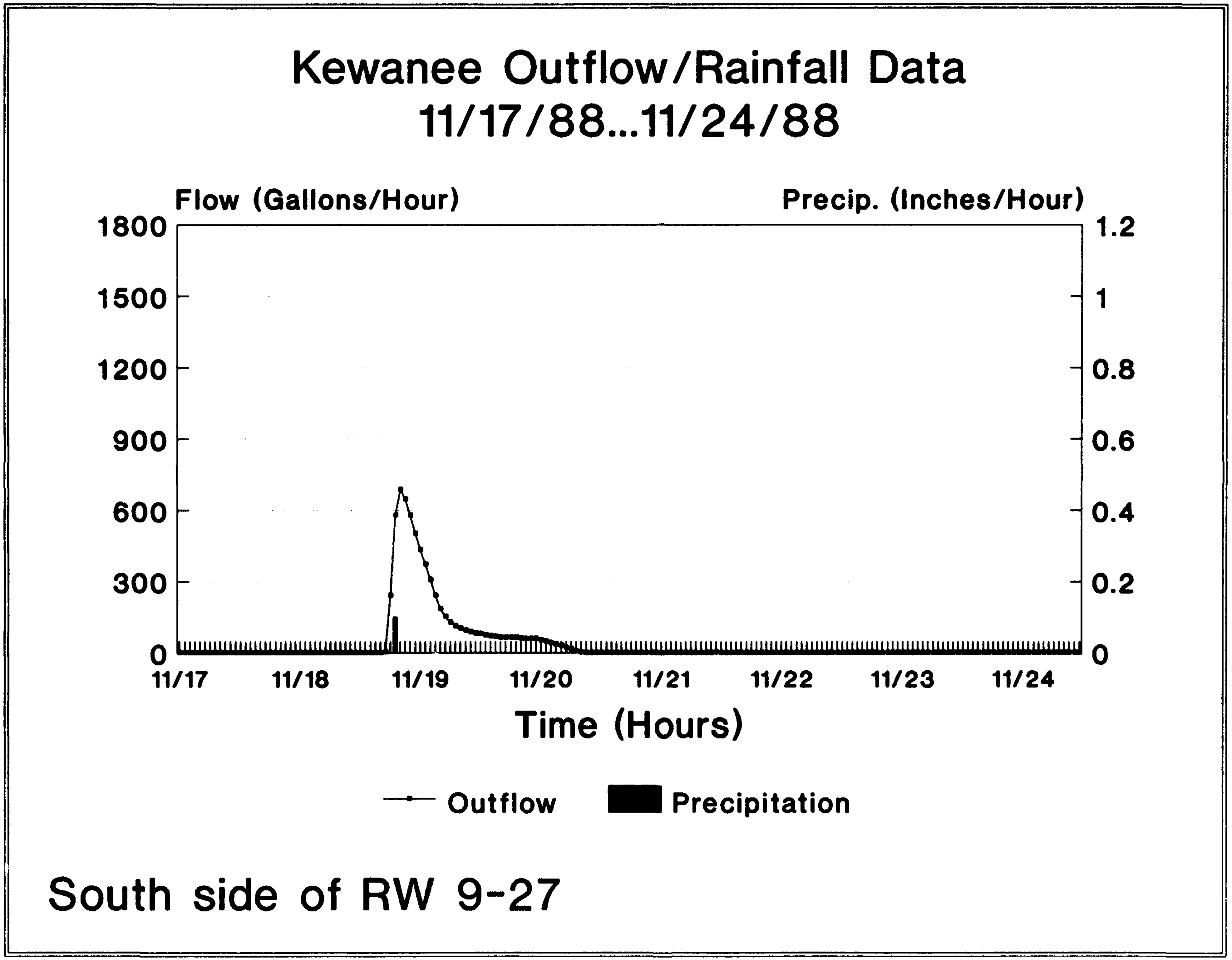

Figure 22. Continued

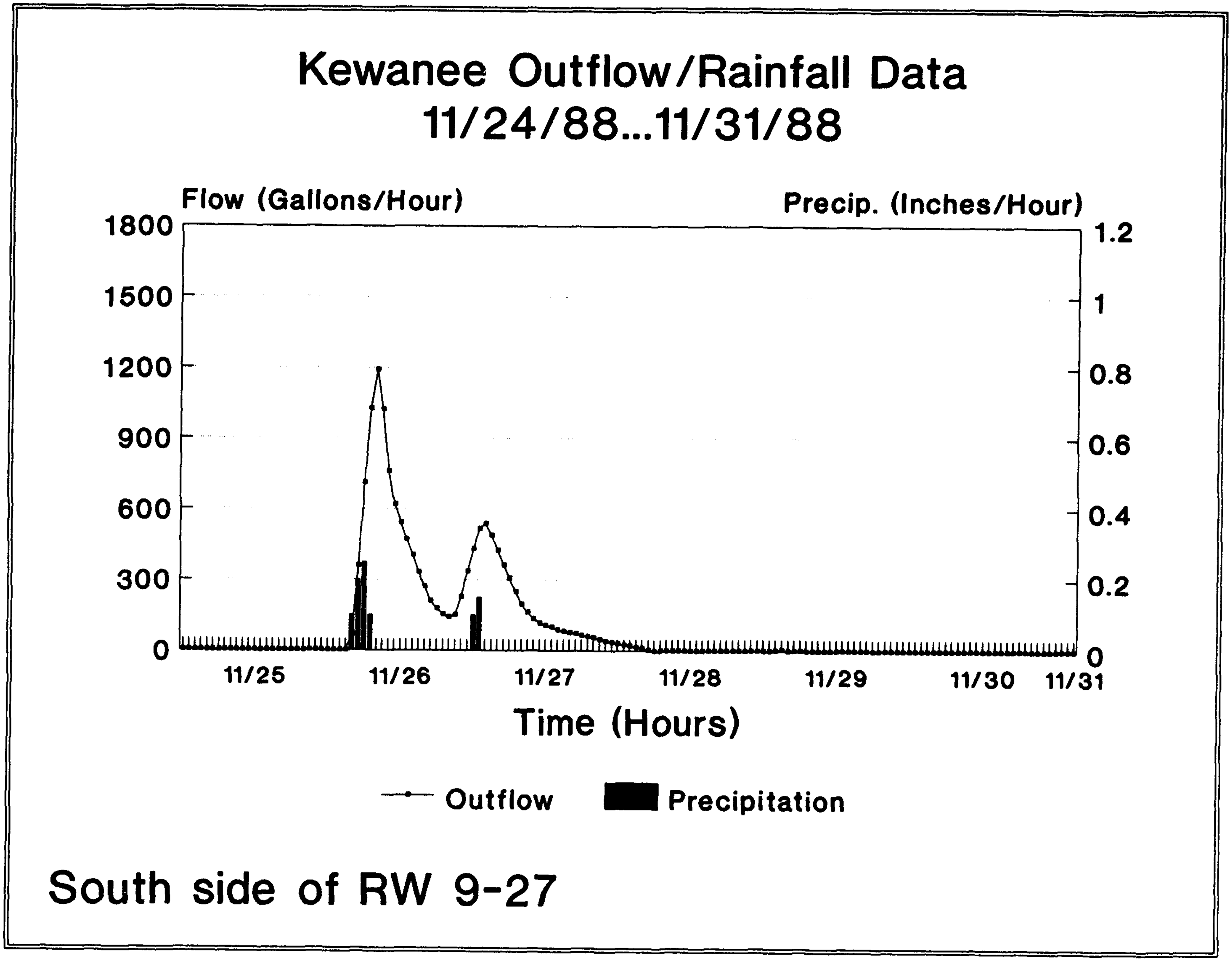

Figure 22. Continued

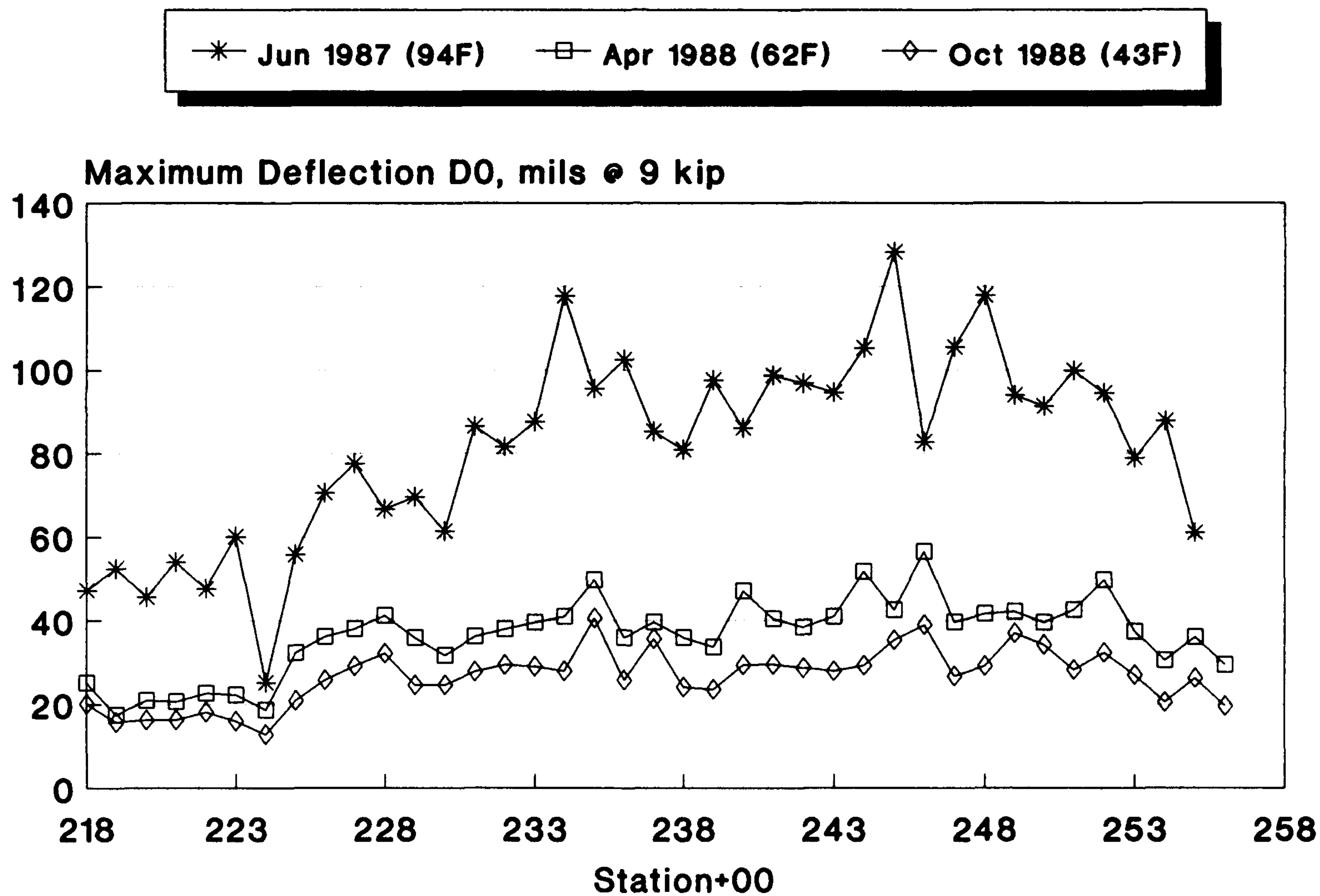

Figure 23. Maximum FWD Deflections, D0,at Kewanee Municipal Airport Runway 09-27 on Various Dates and at Different Pavement Temperatures.

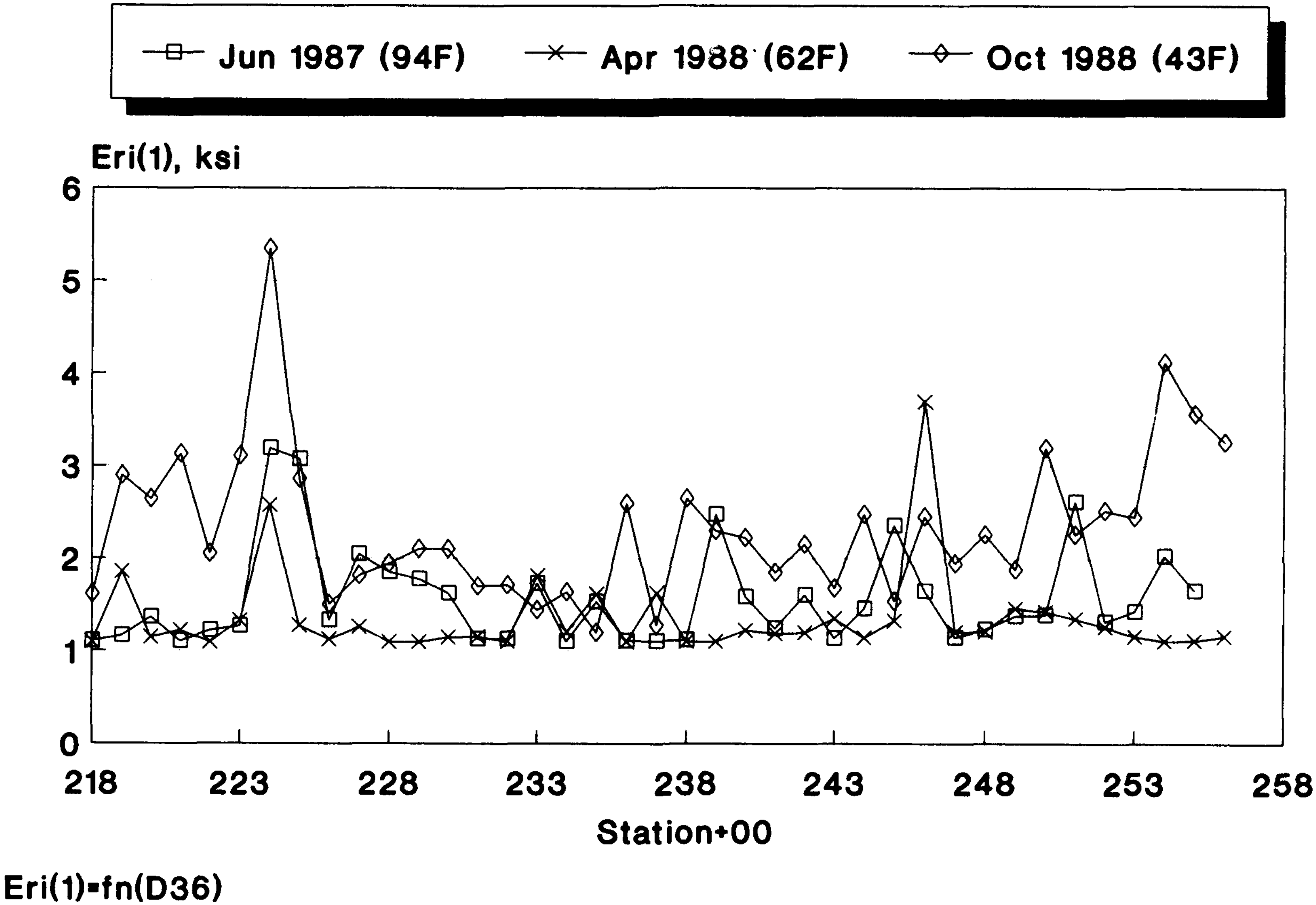

Figure 24. Resilient Modulus for Kewanee Municipal Airport Runway 09-27 Based on D36 and Eq. 2.

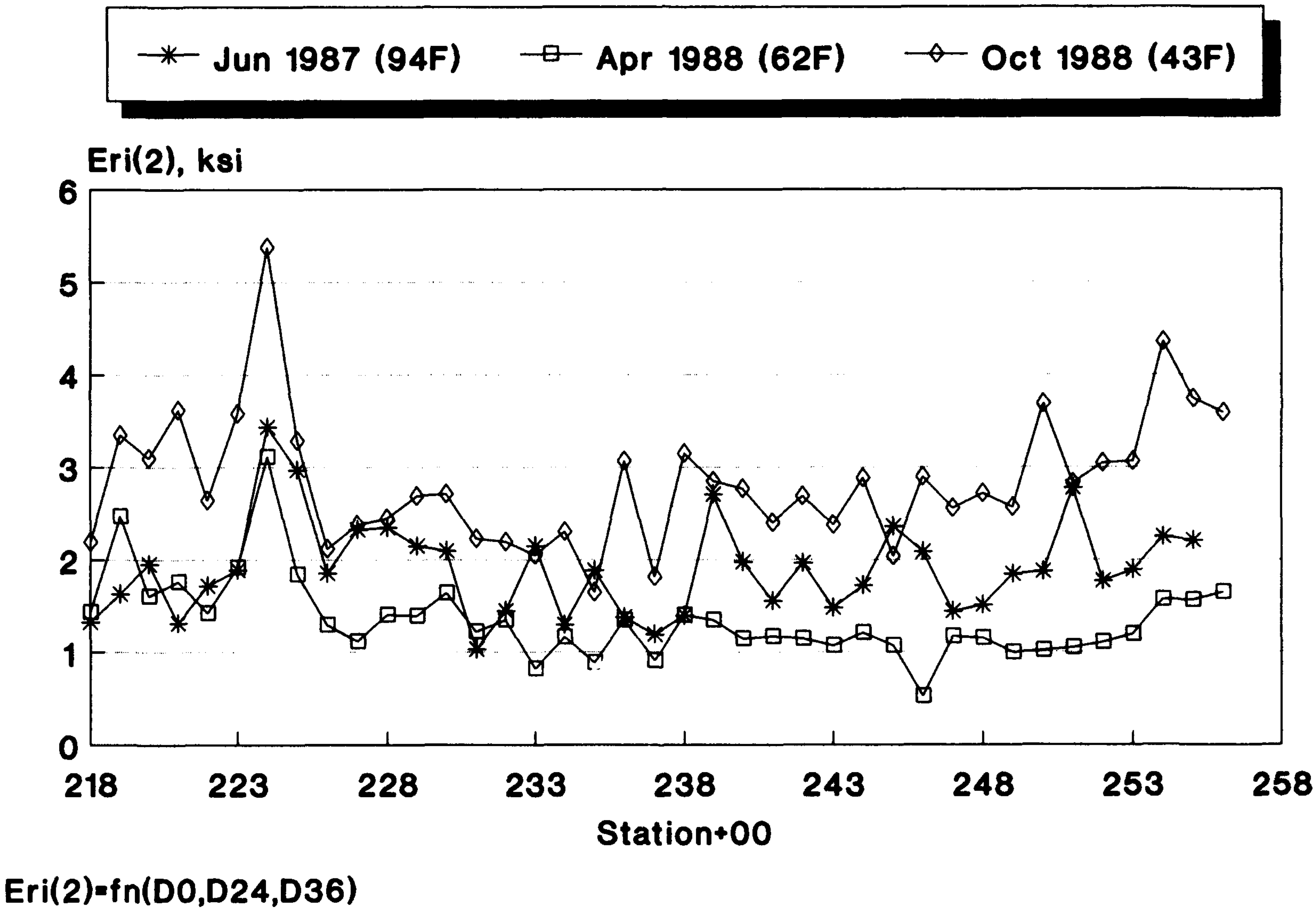

Figure 25. Resilient Modulus for Kewanee Municipal Airport Runway 09-27 Based on D0, D24, D36, and Eq. 3.

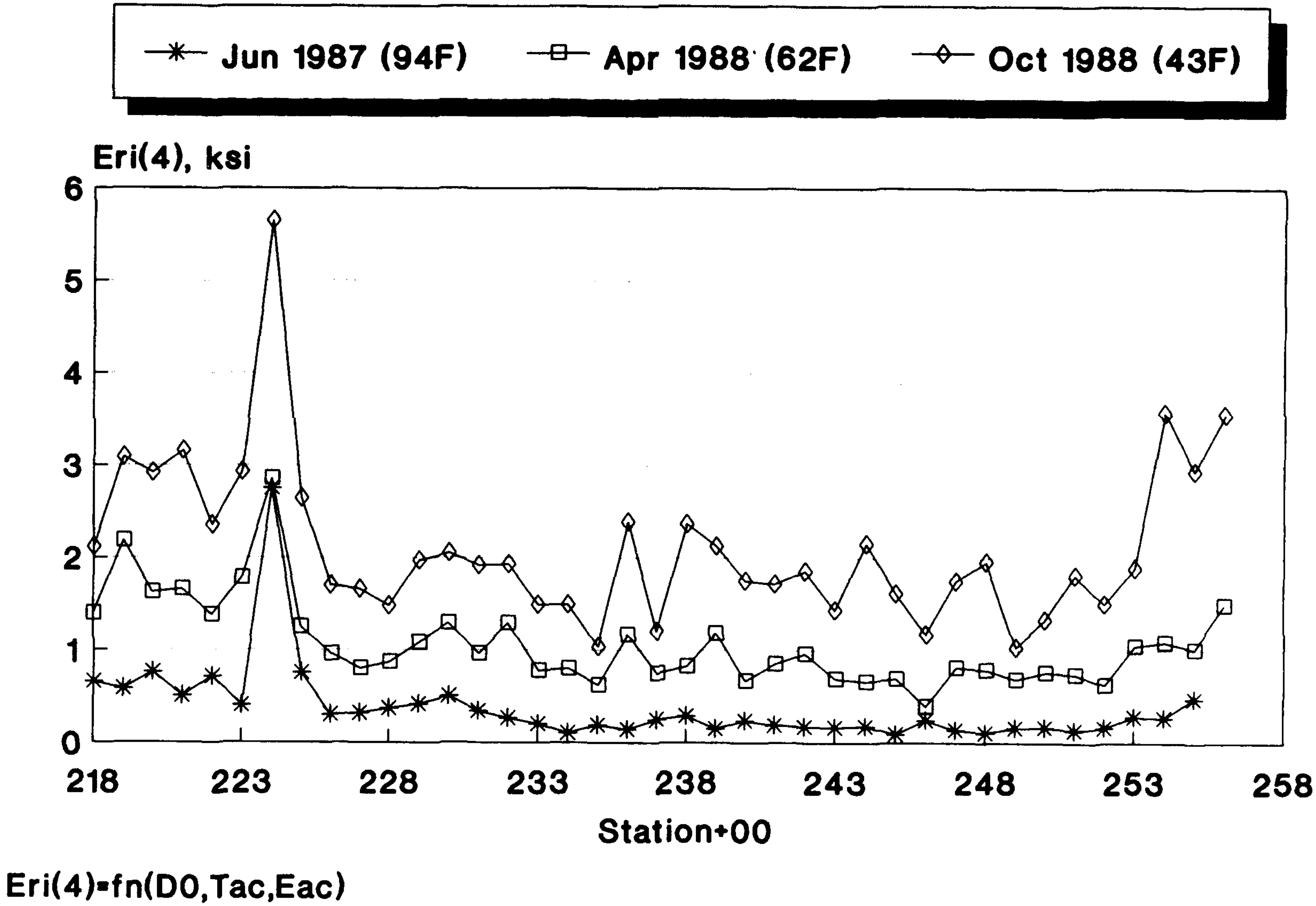

Figure 26. Resilient Modulus for Kewanee Municipal Airport Runway 09-27 Based on D0, Tac, Eac, and Eq. 5.

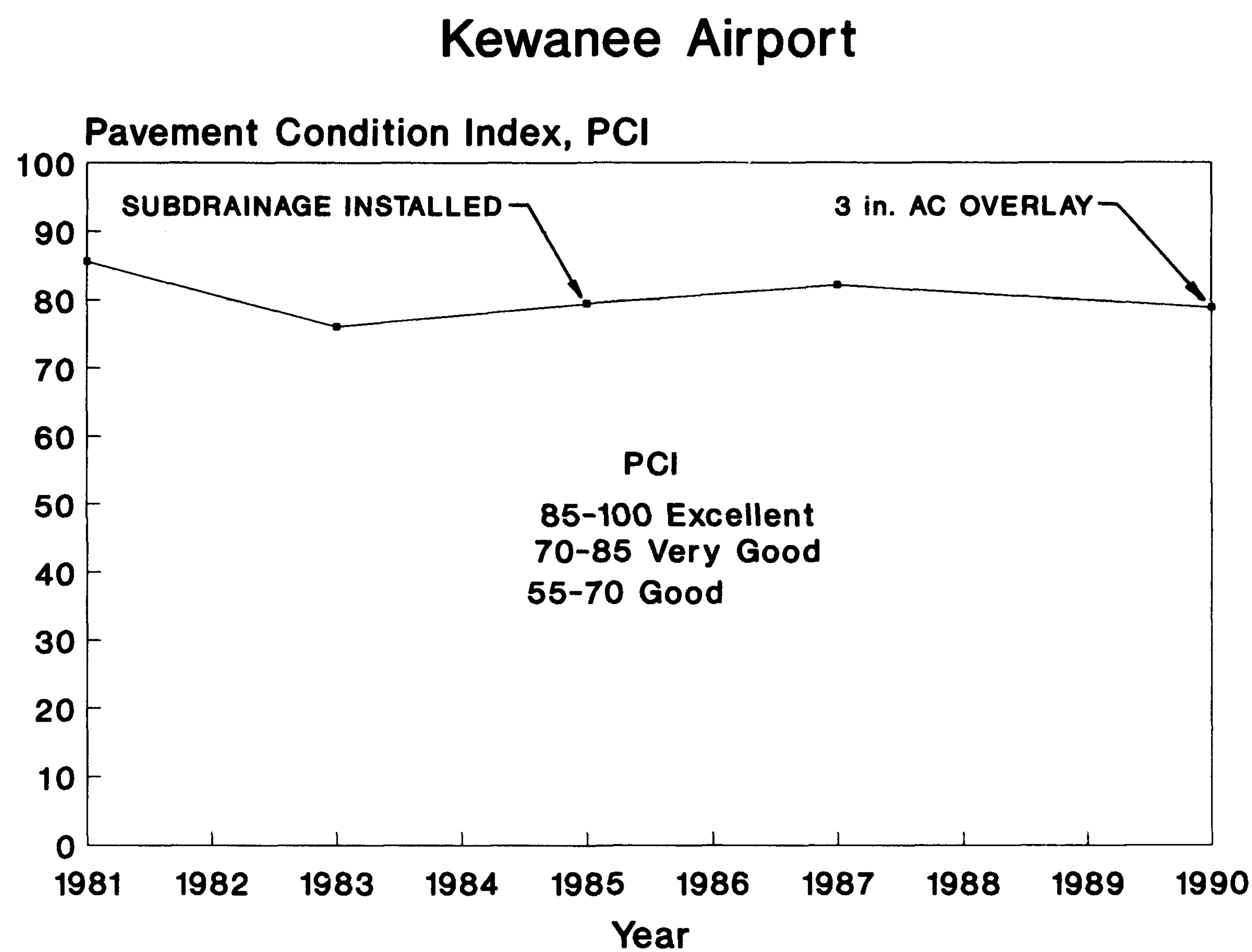

Figure 27. Pavement Condition Index for Kewanee Municipal Airport Runway 09-27.

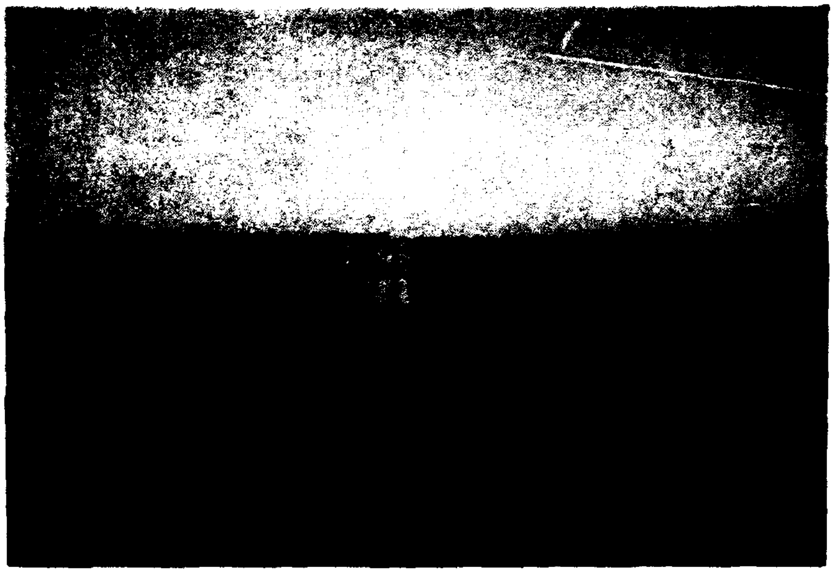

Figure 28. View Along Centerline of Runway 09-27 (Note PGS Installation Joints Parallel to the Centerline).

Figure 29. Asphalt Concrete Plug Located Over the PGS System in Runway 09-27.

APPENDIX A

FIELD DATA FROM

FALLING WEIGHT DEFLECTOMETER

PAV. TYPE: FOR FULL DEPTH AC
PAVEMENT NAME: KEWANEE MUNICIPAL AP
DATE: JUN 17,1987
AIR TEMP.: 82 PAV. TEMP.: 94

* * * * * * * * * * * * * * F I E L D D A T A * * * * * * * * * * * * * *

STATION	LOAD	DO	D1	D2	D3	COMMENTS	
1.00	9206.	62.48	34.92	17.13	7.56	WBO	0
2.00	8920.	87.05	41.85	17.24	6.93	EBO	0
3.00	9031.	79.21	42.20	18.78	7.72	WBO	0
4.00	8952.	94.02	48.94	20.79	7.83	EBO	0
5.00	8872.	98.39	48.58	18.31	6.42	WBO	0
6.00	8999.	91.38	48.78	20.63	7.76	EBO	0
7.00	8936.	93.31	49.17	20.63	7.72	WBO	0
8.00	8745.	114.61	57.32	21.34	7.83	EBO	0
9.00	8809.	103.27	53.31	21.54	8.15	WBO	0
10.00	9015.	82.95	43.86	18.62	7.40	EBO	0
11.00	8506.	121.26	51.57	18.94	6.34	WBO	0
12.00	8904.	104.13	49.06	19.45	7.56	EBO	0
13.00	8904.	93.70	50.16	21.30	8.27	WBO	0
14.00	8952.	96.42	48.70	19.45	7.40	EBO	0
15.00	8872.	97.44	49.09	19.92	7.91	WBO	0
16.00	9015.	86.26	44.65	18.70	7.48	EBO	0
17.00	8840.	95.91	47.13	18.43	6.50	WBO	0
18.00	9047.	81.42	44.02	19.72	8.50	EBO	0
19.00	8983.	85.16	46.34	20.79	8.90	WBO	0
20.00	8856.	100.83	53.23	21.69	8.35	EBO	0
21.00	8888.	94.41	47.44	19.17	7.44	WBO	0
22.00	8745.	114.49	57.99	22.83	8.35	EBO	0
23.00	8936.	87.05	45.55	18.82	7.24	WBO	0
24.00	9015.	81.77	44.57	19.92	8.43	EBO	0
25.00	8968.	86.30	43.98	19.49	9.02	WBO	0
26.00	9174.	62.56	35.55	16.57	7.56	EBO	0
27.00	9095.	70.39	37.80	16.69	7.32	WBO	0
28.00	9095.	67.44	37.87	17.09	7.24	EBO	0
29.00	9047.	78.11	41.10	16.81	7.01	WBO	0
30.00	9063.	71.06	41.42	18.74	7.91	EBO	0
31.00	9254.	57.40	31.93	13.23	6.38	WBO	0
32.00	9429.	26.38	17.64	10.63	6.42	EBO	0
33.00	9063.	60.47	36.02	18.35	8.03	WBO	0
34.00	9190.	48.62	30.94	16.30	8.27	EBO	0
35.00	9222.	55.28	35.35	18.58	9.13	WBO	0
36.00	9270.	47.01	29.84	15.98	8.03	EBO	0
37.00	9270.	54.02	33.74	17.40	8.50	WBO	0
38.00	9317.	48.86	32.05	17.83	9.21	EBO	0

PAV. TYPE: FOR FULL DEPTH AC
PAVEMENT NAME: KEWANEE MUNICIPAL AP
DATE: APR 18,1988
AIR TEMP.: 50 PAV. TEMP.: 62

****************F I E L D   D A T A****************

STATION	LOAD	DO	D1	D2	D3	COMMENTS	
1.00	9429.	30.71	21.85	14.29	8.66	WBO	0
2.00	9460.	37.87	26.10	16.06	8.94	EBO	0
3.00	9588.	32.40	23.94	15.67	9.13	WBO	0
4.00	9429.	39.17	26.57	16.73	9.61	EBO	0
5.00	9079.	50.20	31.97	18.62	9.53	WBO	0
6.00	9429.	44.57	30.28	18.50	10.08	EBO	0
7.00	9492.	41.61	29.29	18.46	10.28	WBO	0
8.00	9476.	44.41	30.91	18.94	10.31	EBO	0
9.00	9381.	43.35	29.45	17.80	9.72	WBO	0
10.00	9397.	41.38	28.70	17.56	9.72	EBO	0
11.00	9063.	56.93	38.74	22.48	11.69	WBO	0
12.00	9476.	44.76	30.98	18.62	10.08	EBO	0
13.00	9349.	53.74	32.87	18.58	9.45	WBO	0
14.00	9429.	42.91	30.24	18.50	10.08	EBO	0
15.00	9460.	40.43	27.56	17.17	9.76	WBO	0
16.00	9445.	42.36	28.82	17.52	9.72	EBO	0
17.00	9238.	48.23	31.42	18.46	9.61	WBO	0
18.00	9413.	35.24	24.57	15.79	9.25	EBO	0
19.00	9476.	37.83	27.44	16.73	9.33	WBO	0
20.00	9365.	41.26	29.29	18.43	10.43	EBO	0
21.00	9460.	37.72	25.47	16.02	9.25	WBO	0
22.00	9206.	50.91	33.07	19.33	10.24	EBO	0
23.00	9397.	42.76	29.17	17.76	9.72	WBO	0
24.00	9381.	41.18	29.33	18.39	10.67	EBO	0
25.00	9317.	39.17	25.24	15.43	8.98	WBO	0
26.00	9349.	37.52	26.50	16.46	9.49	EBO	0
27.00	9460.	33.27	23.43	14.92	8.74	WBO	0
28.00	9413.	37.56	25.83	15.94	9.13	EBO	0
29.00	9397.	43.07	28.74	16.73	9.09	WBO	0
30.00	9349.	39.53	28.23	17.36	9.80	EBO	0
31.00	9413.	37.76	26.57	16.54	9.41	WBO	0
32.00	9429.	33.86	23.82	14.45	8.35	EBO	0
33.00	9588.	19.80	15.08	10.59	6.97	WBO	0
34.00	9556.	23.62	18.31	12.80	8.35	EBO	0
35.00	9604.	24.13	19.37	13.98	9.29	WBO	0
36.00	9556.	21.89	17.64	12.72	8.58	EBO	0
37.00	9540.	22.09	17.80	12.95	8.82	WBO	0
38.00	9604.	18.62	15.16	11.10	7.64	EBO	0
39.00	9476.	26.46	20.47	14.17	9.13	WBO	0

PAV. TYPE: FOR FULL DEPTH AC
PAVEMENT NAME: KEWANEE MUNICIPAL AP
DATE: OCT 11,1988
AIR TEMP.: 55 PAV. TEMP.: 43

* * * * * * * * * * * * * * * F I E L D D A T A * * * * * * * * * * * * * * *

STATION	LOAD	D0	D1	D2	D3	COMMENTS	
1.00	9556.	20.75	14.84	10.00	6.46	WBO	0
2.00	9365.	27.24	17.28	10.43	6.14	EBO	0
3.00	9429.	21.46	14.92	9.49	5.87	WBO	0
4.00	9508.	28.50	19.76	12.17	7.01	EBO	0
5.00	9365.	33.58	22.24	12.56	6.85	WBO	0
6.00	9397.	29.45	20.28	12.24	7.09	EBO	0
7.00	9317.	35.31	22.91	12.32	6.34	WBO	0
8.00	9238.	37.87	25.24	14.09	7.32	EBO	0
9.00	9238.	29.88	20.00	11.89	6.97	WBO	0
10.00	9476.	28.11	20.20	12.48	7.44	EBO	0
11.00	9349.	40.39	25.43	13.27	6.89	WBO	0
12.00	9270.	36.46	22.72	13.62	7.76	EBO	0
13.00	9429.	30.67	19.88	11.89	6.93	WBO	0
14.00	9445.	29.33	21.34	13.27	7.72	EBO	0
15.00	9381.	29.96	20.39	12.28	7.17	WBO	0
16.00	9349.	30.71	21.06	12.68	7.44	EBO	0
17.00	9301.	30.39	20.63	12.28	7.05	WBO	0
18.00	9492.	24.80	18.19	11.54	7.13	EBO	0
19.00	9508.	25.35	17.91	11.30	6.85	WBO	0
20.00	9270.	36.69	24.69	14.53	8.19	EBO	0
21.00	9397.	26.93	18.23	11.42	6.81	WBO	0
22.00	9301.	41.93	27.20	15.31	8.43	EBO	0
23.00	9238.	28.62	20.75	12.91	7.60	WBO	0
24.00	9286.	29.96	21.38	13.35	7.91	EBO	0
25.00	9349.	30.47	20.59	12.56	7.60	WBO	0
26.00	9429.	29.13	20.24	12.60	7.68	EBO	0
27.00	9365.	25.59	18.43	11.85	7.20	WBO	0
28.00	9317.	25.51	18.58	11.73	7.17	EBO	0
29.00	9317.	33.27	22.68	12.80	7.32	WBO	0
30.00	9349.	30.28	21.14	12.68	7.48	EBO	0
31.00	9492.	27.13	20.00	12.95	7.99	WBO	0
32.00	9397.	21.81	16.18	10.39	6.61	EBO	0
33.00	9604.	13.58	10.63	7.60	5.35	WBO	0
34.00	9524.	16.81	13.50	9.61	6.54	EBO	0
35.00	9508.	19.06	15.20	10.87	7.36	WBO	0
36.00	9492.	17.13	13.46	9.65	6.50	EBO	0
37.00	9556.	17.20	13.78	9.92	6.89	WBO	0
38.00	9429.	16.50	13.19	9.57	6.61	EBO	0
39.00	9349.	20.79	16.34	11.46	7.72	EBO	0

*U.S. G.P.O.:1993-301-717:80467